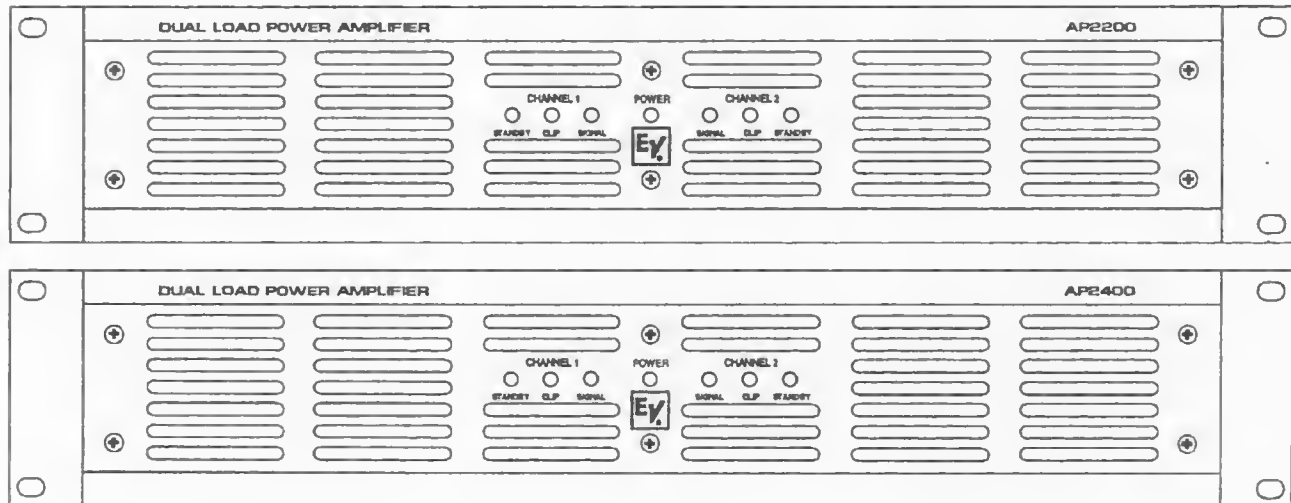




Electro-Voice®

OPERATION MANUAL & SERVICE INSTRUCTIONS

AP2200 & AP2400 AMPLIFIERS





Electro-Voice®

Operation Manual for the
AP2200 & AP2400 amplifiers

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Uniform Limited Warranty Statement

Electro-Voice® products are guaranteed against malfunction due to defects in materials or workmanship for a specified period, as noted in the product-line statement(s) below, or in the individual product data sheet or owner's manual, beginning with the date of original purchase. If such malfunction occurs during the specified period, the product will be repaired or replaced (at our option) without charge. The product will be returned to the customer prepaid.

Exclusions and Limitations: The Limited Warranty does not apply to: (a) exterior finish or appearance; (b) certain specific items described in the individual product-line statement(s) below, or in the individual product data sheet or owner's manual; (c) malfunction resulting from use or operation of the product other than as specified in the product data sheet or owner's manual; (d) malfunction resulting from misuse or abuse of the product; or (e) malfunction occurring at any time after repairs have been made to the product by anyone other than Mark IV Audio Service or any of its authorized service representatives.

Obtaining Warranty Service: To obtain warranty service, a customer must deliver the product, prepaid, to Mark IV Audio Service or any of its authorized service representatives together with proof of purchase of the product in the form of a bill of sale or receipted invoice. A list of authorized service representatives is available from Mark IV Audio Service at 600 Cecil Street, Buchanan, MI 49107 (800-234-6831 or FAX 616-695-4743).

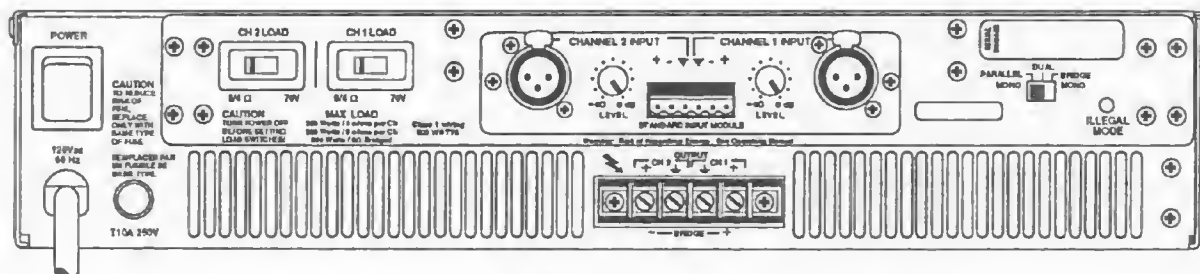
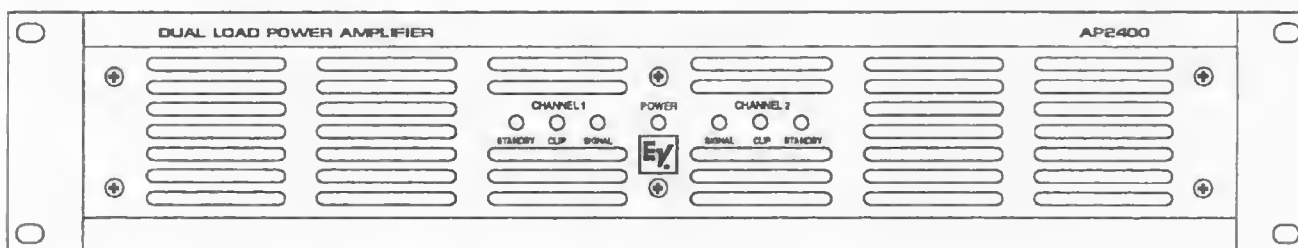
Incidental and Consequential Damages Excluded: Product repair or replacement and return to the customer are the only remedies provided to the customer. Electro-Voice® shall not be liable for any incidental or consequential damages including, without limitation, injury to persons or property or loss of use. Some states do not allow the exclusion or limitation of incidental or consequential damages so the above limitation or exclusion may not apply to you.

Other Rights: This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Electro-Voice® Electronics are guaranteed against malfunction due to defects in materials or workmanship for a period of three (3) years from the date of original purchase. Additional details are included in the Uniform Limited Warranty statement.

PRODUCT DESCRIPTION

The Electro-Voice® AP2200 / AP2400 series amplifiers are designed for direct voice-coil drive and/or 70-volt distributed systems. Each channel can be independently configured for 70-volt line operation or 8/4-ohm systems. The two channels together can be paralleled or bridged for driving a single load. This series features an ultraquiet continuously variable cooling system which pulls air from front to back. An air filter is provided and can be removed from the front for cleaning. The input module is removable and comes standard with both XLR and screw terminal connectors. Optional accessories for signal processing plug into the input module. Optional control modules allow compatibility and connection to an Interactive Technology network. Each channel is protected against load shorts, overtemperature and output dc. The front panel indicators provide signal present, signal clip and standby for each channel as well as a power on indicator.



UNPACKING

This shipping carton is specially designed to protect the amplifier while transporting under normal conditions. It is still possible for damage to occur so carefully inspect the outside carton for signs of abuse. If for any reason the amplifier should be returned, use the shipping carton that it came in. Electro-Voice® cannot warranty against damage that occurs as a result of improper packaging.

PRECAUTIONS

Do not replace the fuse with a higher amp rating than what is specified. There are various circuits inside that detect fault conditions and place the amplifier in standby (indicated on the front panel by the amber LEDs). A blown ac panel fuse indicates a more severe problem such as a transformer failure. An oversized fuse installed under these conditions can lead to a possible fire hazard.

There is a thermal fuse located inside the transformer primary windings to protect against unusual conditions that the amplifier fault logic may not sense. For example, a leaky power supply capacitor can cause excessive current to flow therefore heating up the transformer, yet the amplifier appears to perform normally. If the amplifier is operating under extreme conditions that cause the transformer to overheat, it is possible for this thermal fuse to trip before either the back panel fuse blows or the amplifier engages a standby condition. In this case, the internal transformer fuse will remain open (no power) until the temperature inside the transformer drops to a safe level. At that time the fuse will close and power will again be applied. This shut-down condition can be recognized by a total power lost even though the panel fuse is good. This contrasts against a thermal shut-down by the fault logic where the power and stand-by LEDs on the front panel are brightly lit and the internal fan may be running.



Electro-Voice®

Operation Manual for the
AP2200 & AP2400 amplifiers

SPECIFICATIONS

All output power specifications are for < 0.1% THD, 20-20kHz, both channels driven (30kHz measurement bandwidth).

| RATED POWER: (Watts) | AP2200 | AP2400 |
|-----------------------------|---------------|---------------|
| Dual Mode | | |
| 4-ohm | 150 | 250 |
| 8-ohm | 100 | 200 |
| 70-volt | 100 | 200 |
| Parallel Mono | | |
| 2-ohm | 300 | 500 |
| 4-ohm | 200 | 400 |
| 8-ohm | 100 | 200 |
| 70-volt | 200 | 400 |
| Bridged Mono | | |
| 8-ohm | 300 | 500 |
| 16-ohm | 200 | 400 |
| 140-volt | 200 | 400 |

FREQUENCY RESPONSE

10 Hz to 80kHz (ref. 1kHz, 1 watt output, + 0/-3 dBr)

POWER BANDWIDTH

20Hz to 20kHz

(ref. 1kHz, +0/-0.5 dBr where 0 dBr = rated output power in any mode)

| VOLTAGE GAIN: (ref. 1 kHz) | AP2200 | AP2400 |
|-----------------------------------|---------------|---------------|
| Dual Mode | | |
| 4/8-ohm | 31.2 dBu | 34.2 dBu |
| 70-volt | 39.2 dBu | 39.2 dBu |
| Parallel Mono | | |
| 2/4/8-ohm | 31.2 dBu | 34.2 dBu |
| 70-volt | 39.2 dBu | 39.2 dBu |
| Bridged Mono | | |
| 8/16-ohm | 37.2 dBu | 40.2 dBu |
| 140-volt | 45.2 dBu | 45.2 dBu |

SIGNAL TO NOISE:

> 100 dBr (A wtd.) measured below rated output

THD:

< 0.1% 20-20 kHz for rated power

(any mode, 30kHz measurement bandwidth)

| SENSITIVITY | AP2200 | AP2400 |
|----------------------|-----------------------|---------------------|
| 8 ohm / 70 V / 140 V | 0 dBu (0.775 Vrms) | 0 dBu (0.775 Vrms) |
| 4Ω / 2Ω / 8Ω brg | -1.2 dBu (0.647 Vrms) | -2 dBu (0.616 Vrms) |

INPUT IMPEDANCE: 20k Ohms

SOURCE IMPEDANCE: 0.032 Ohms

CROSS TALK: < -70 dB at 1kHz

DC OFFSET: Less than 5 mV

SLEW RATE: 15 V/μs

DAMPING FACTOR: > 300 (1 kHz, 8-ohm)

AC POWER: 120 V ac / 60 Hz

MINIMUM AC VOLTAGE: 95 V ac / 60 Hz

POWER CONSUMPTION AND THERMAL DISSIPATION

The following tables provide guidelines for estimating heat dissipation of each amplifier, given its intended application. This data is based on the following equation:

$$P_{dis} = P_{ac} - P_{ld}$$

P_{dis} = Power Dissipated in Watts

P_{ac} = True AC Mains Power in Watts Consumed

P_{ld} = Total Average Power Delivered to the Load

The applications are as follows:

Idle: The amplifier is on with no signal present.

Paging/Background Music: The amplifier is operating with one second announcements (at full power) every 15 seconds or background music which is attenuated -32 dB.

Continuous Speech: The amplifier is operating with continuous speech that is attenuated -23 dB.

Dynamic: The amplifier is operating with a dynamic input signal such as a motion-picture sound track or classical music. Loud passages are at full power, soft passages are equivalent to continuous speech.

Full Music Power: The amplifier is operating with continuous music input at rated output to the load with only occasional clipping.

Conditions for following measurements:

Line = 120 V ac • Both channels driven equally and with equal loads for dual mode measurements

AP2200

Line Current, Power Consumed/Dissipated and Output for selected applications

| Application: Idle | | | | | | |
|--------------------------------------|------------------|---------|---------|---------|--------|---------|
| Load | Line Current (A) | Pac (W) | Pld (W) | Pdi (W) | Btu/Hr | Kcal/Hr |
| 2 ohm Parallel | .37 | 28 | 0 | 28 | 89 | 22 |
| 4 ohm Dual | .41 | 29 | 0 | 29 | 99 | 25 |
| 8 ohm Dual | .41 | 29 | 0 | 29 | 99 | 25 |
| 8 ohm Bridged | .43 | 30 | 0 | 30 | 102 | 26 |
| 70 V Dual | .54 | 38 | 0 | 38 | 130 | 33 |
| 70 V Parallel | .50 | 35 | 0 | 35 | 120 | 30 |
| 140 V Bridged | .54 | 38 | 0 | 38 | 130 | 33 |
| Application: Paging/Background Music | | | | | | |
| Load | Line Current (A) | Pac (W) | Pld (W) | Pdi (W) | Btu/Hr | Kcal/Hr |
| 2 ohm Parallel | .78 | 48 | .27 | 47.7 | 163 | 41 |
| 4 ohm Dual | .81 | 51 | .27 | 50.7 | 173 | 44 |
| 8 ohm Dual | .63 | 40 | .18 | 39.8 | 136 | 34 |
| 8 ohm Bridged | .81 | 51 | .27 | 50.7 | 173 | 44 |
| 70 V Dual | .70 | 44 | .18 | 43.8 | 150 | 38 |
| 70 V Parallel | .66 | 42 | .18 | 41.8 | 143 | 36 |
| 140 V Bridged | .70 | 44 | .18 | 43.8 | 150 | 38 |
| Application: Continuous Speech | | | | | | |
| Load | Line Current (A) | Pac (W) | Pld (W) | Pdi (W) | Btu/Hr | Kcal/Hr |
| 2 ohm Parallel | 1.35 | 104 | 3 | 101 | 345 | 87 |
| 4 ohm Dual | 1.39 | 107 | 3 | 104 | 356 | 89 |
| 8 ohm Dual | .95 | 73 | 2 | 71 | 242 | 61 |
| 8 ohm Bridged | 1.39 | 106 | 3 | 103 | 352 | 89 |
| 70 V Dual | .88 | 68 | 2 | 66 | 225 | 57 |
| 70 V Parallel | .86 | 66 | 2 | 64 | 219 | 55 |
| 140 V Bridged | .88 | 68 | 2 | 66 | 225 | 57 |
| Application: Dynamic | | | | | | |
| Load | Line Current (A) | Pac (W) | Pld (W) | Pdi (W) | Btu/Hr | Kcal/Hr |
| 2 ohm Parallel | 2.60 | 228 | 15.9 | 210 | 717 | 181 |
| 4 ohm Dual | 2.43 | 210 | 15.9 | 194 | 663 | 167 |
| 8 ohm Dual | 1.75 | 145 | 13 | 132 | 451 | 114 |
| 8 ohm Bridged | 2.45 | 212 | 15.9 | 196 | 669 | 169 |
| 70 V Dual | 1.52 | 122 | 13 | 109 | 372 | 94 |
| 70 V Parallel | 1.50 | 120 | 13 | 107 | 365 | 92 |
| 140 V Bridged | 1.51 | 123 | 13 | 110 | 375 | 95 |
| Application: Full Music Power | | | | | | |
| Load | Line Current (A) | Pac (W) | Pld (W) | Pdi (W) | Btu/Hr | Kcal/Hr |
| 2 ohm Parallel | 3.59 | 335 | 48 | 287 | 980 | 247 |
| 4 ohm Dual | 3.88 | 344 | 48 | 296 | 1011 | 255 |
| 8 ohm Dual | 2.27 | 212 | 32 | 180 | 615 | 155 |
| 8 ohm Bridged | 3.65 | 341 | 48 | 293 | 1001 | 252 |
| 70 V Dual | 1.88 | 175 | 32 | 143 | 488 | 123 |
| 70 V Parallel | 1.84 | 172 | 32 | 140 | 478 | 120 |
| 140 V Bridged | 1.88 | 175 | 32 | 143 | 488 | 122 |

AP2400

Line Current, Power Consumed/Dissipated and Output for selected applications

| Application: Idle | | | | | | |
|--------------------------------------|------------------|---------|---------|---------|--------|---------|
| Load | Line Current (A) | Pac (W) | Pld (W) | Pdi (W) | Btu/Hr | Kcal/Hr |
| 2 ohm Parallel | .44 | 29 | 0 | 29 | 99 | 25 |
| 4 ohm Dual | .55 | 42 | 0 | 42 | 143 | 36 |
| 8 ohm Dual | .55 | 42 | 0 | 42 | 143 | 36 |
| 8 ohm Bridged | .52 | 36 | 0 | 36 | 123 | 31 |
| 70 V Dual | .58 | 45 | 0 | 45 | 154 | 39 |
| 70 V Parallel | .50 | 35 | 0 | 35 | 120 | 30 |
| 140 V Bridged | .60 | 47 | 0 | 47 | 161 | 41 |
| Application: Paging/Background Music | | | | | | |
| Load | Line Current (A) | Pac (W) | Pld (W) | Pdi (W) | Btu/Hr | Kcal/Hr |
| 2 ohm Parallel | .85 | 65 | .45 | 64.5 | 220 | 55 |
| 4 ohm Dual | .75 | 58 | .45 | 57.5 | 196 | 49 |
| 8 ohm Dual | .80 | 70 | .36 | 69.6 | 238 | 60 |
| 8 ohm Bridged | .89 | 70 | .45 | 69.6 | 237 | 60 |
| 70 V Dual | .78 | 62 | .36 | 61.6 | 210 | 53 |
| 70 V Parallel | .74 | 58 | .36 | 57.6 | 197 | 50 |
| 140 V Bridged | .77 | 61 | .36 | 60.6 | 207 | 52 |
| Application: Continuous Speech | | | | | | |
| Load | Line Current (A) | Pac (W) | Pld (W) | Pdi (W) | Btu/Hr | Kcal/Hr |
| 2 ohm Parallel | 1.87 | 154 | 6 | 149 | 508 | 128 |
| 4 ohm Dual | 1.84 | 161 | 5 | 156 | 533 | 134 |
| 8 ohm Dual | 1.41 | 113 | 4 | 109 | 372 | 94 |
| 8 ohm Bridged | 1.91 | 159 | 5 | 154 | 526 | 133 |
| 70 V Dual | 1.40 | 113 | 4 | 109 | 372 | 94 |
| 70 V Parallel | 1.38 | 110 | 4 | 106 | 362 | 91 |
| 140 V Bridged | 1.38 | 111 | 4 | 107 | 365 | 92 |
| Application: Dynamic | | | | | | |
| Load | Line Current (A) | Pac (W) | Pld (W) | Pdi (W) | Btu/Hr | Kcal/Hr |
| 2 ohm Parallel | 3.55 | 317 | 26.3 | 291 | 994 | 250 |
| 4 ohm Dual | 3.80 | 321 | 26.3 | 295 | 1007 | 254 |
| 8 ohm Dual | 2.53 | 218 | 21.2 | 197 | 673 | 170 |
| 8 ohm Bridged | 3.80 | 321 | 26.3 | 295 | 1007 | 254 |
| 70 V Dual | 2.46 | 208 | 21.8 | 186 | 635 | 160 |
| 70 V Parallel | 2.42 | 204 | 21.6 | 182 | 622 | 157 |
| 140 V Bridged | 2.47 | 210 | 21.6 | 188 | 642 | 162 |
| Application: Full Music Power | | | | | | |
| Load | Line Current (A) | Pac (W) | Pld (W) | Pdi (W) | Btu/Hr | Kcal/Hr |
| 2 ohm Parallel | 5.50 | 520 | 80 | 440 | 1503 | 379 |
| 4 ohm Dual | 5.85 | 535 | 80 | 455 | 1554 | 391 |
| 8 ohm Dual | 3.93 | 353 | 64 | 289 | 987 | 249 |
| 8 ohm Bridged | 5.81 | 535 | 80 | 455 | 1554 | 392 |
| 70 V Dual | 3.72 | 332 | 64 | 268 | 915 | 231 |
| 70 V Parallel | 3.72 | 331 | 64 | 267 | 912 | 230 |
| 140 V Bridged | 3.65 | 325 | 64 | 261 | 891 | 225 |

| PHYSICAL: | AP2200 | AP2400 |
|------------------|---------------------|---------------------|
| Depth: | 16 in. (406.4mm) | 16 in. (406.4mm) |
| Width: | 19 in. (482.6mm) | 19 in. (482.6mm) |
| Height: | 3.4 in. (88.1mm) | 3.4 in. (88.1mm) |
| Weight: | 29.75 lb (13.49 kg) | 30.75 lb (13.95 kg) |
| Shipping Weight: | 33.87 lb (15.36 kg) | 34.87 lb (15.81 kg) |

INPUT CONNECTIONS

Balanced input connections may be made to either the wire terminals or the XLR connectors. For single-ended unbalanced signal sources, the negative terminal (pin 3 of the XLR) should be connected to ground (pin 1 of the XLR). The screw terminal connections are wired directly to the XLR pins. XLR pin 1 corresponds to the screw terminal marked with a ground symbol. XLR pins 2 and 3 correspond to the terminals marked "+" and "-" respectively. The screw terminals may be used for an auxiliary output if the input signal is to be routed to multiple amplifiers. Another application for the screw terminals is to provide a convenient place for a termination resistor. A 600 ohm resistor connected across the "+" and "-" screw terminals is equivalent to loading pins 2 and 3 of the XLR input. Refer to Figure 1 for typical connections.

XLR PIN 1 GROUND JUMPER

To help facilitate various grounding connections for pin 1 of the XLR connectors (and the Input terminal ground), a three pin jumper is provided on the standard input module. The jumper is located near the channel two XLR connector. This jumper connects pin 1 of both XLR connectors to either the chassis ground (indicated by the earth symbol) or signal ground (indicated by the triangle symbol). The unit is shipped with pin 1 connected to the chassis. This position offers the best isolation from ground loops and noise if you use a uniformly shielded twisted pair cable that does not include a drain wire. You should only use the signal ground position if you are using unbalanced signal sources.

Figure 1a Balanced source using header input

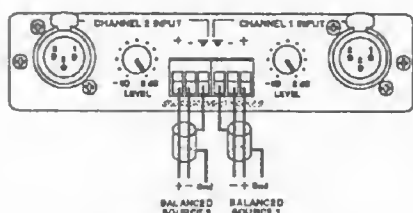


Figure 1b Unbalanced source using header input

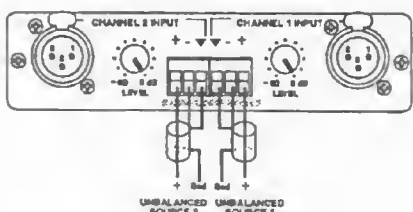


Figure 1c Alternate connection for unbalanced sources using header input

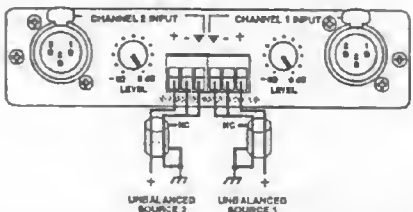


Figure 1d Balanced source with auxiliary out

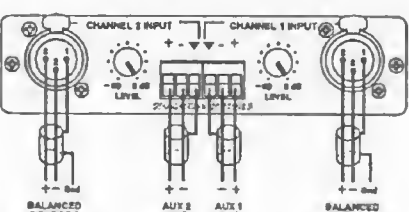


Figure 1f Unbalanced source with auxiliary out

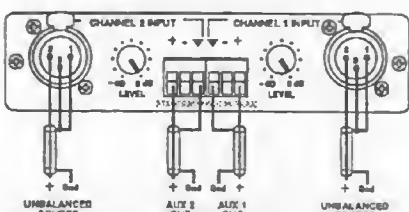


Figure 1e Balanced source with termination resistors

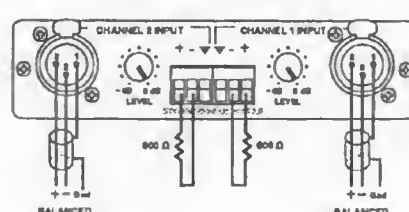
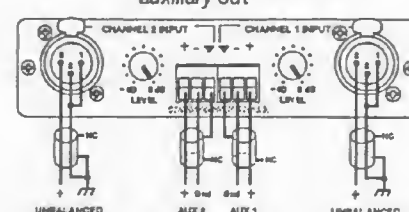


Figure 1g Alternate connection for unbalanced sources with auxiliary out



OUTPUT CONNECTIONS, CONFIGURATIONS

Speaker output connections are made to the four-terminal barrier-strip connector located below the input module. The output configurations are determined by the three-position mode switch located to the right of the input module, and the load switches located to the left of the input module.

Caution: Replace output cover after speakers are connected. Do not expose bare wires and terminals.

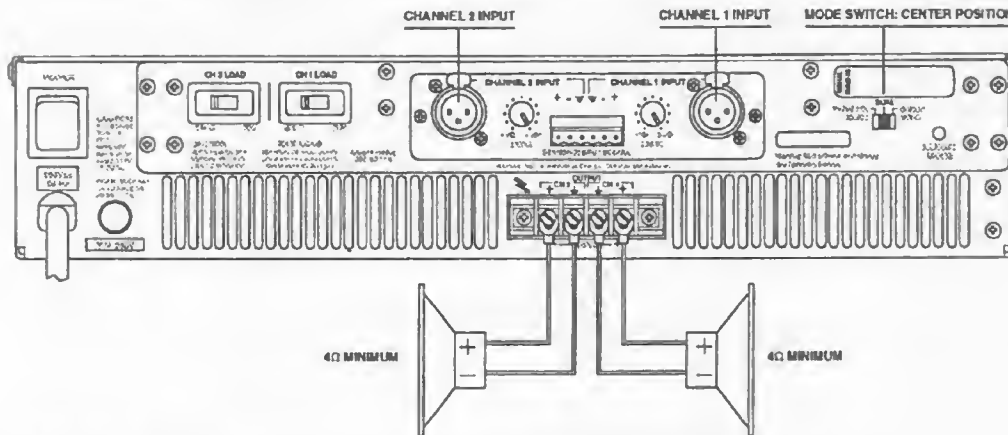


Figure 2a Dual (Stereo) Mode Connections

Dual Mode - In this configuration the amplifier is operating as two independent power amplifiers. Each speaker load can be independently configured for 8/4-ohm or 70-Volt line operation using the load switches located to the left of the input module (Figure 2a).

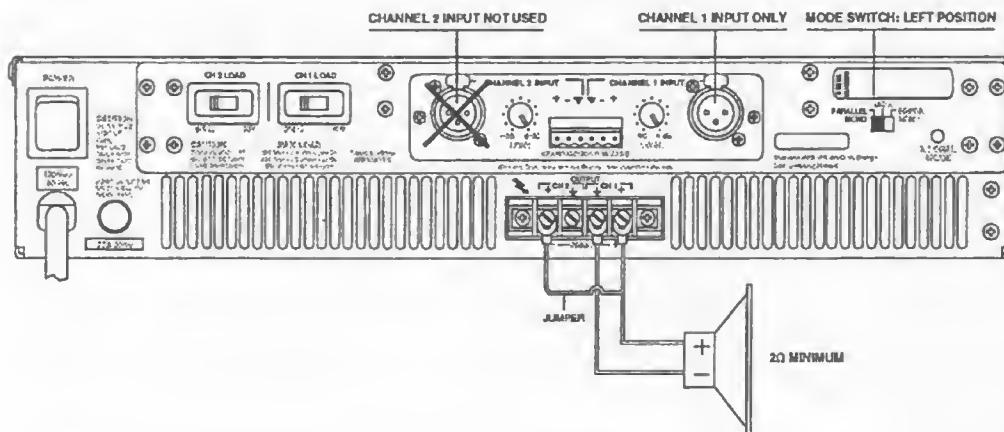


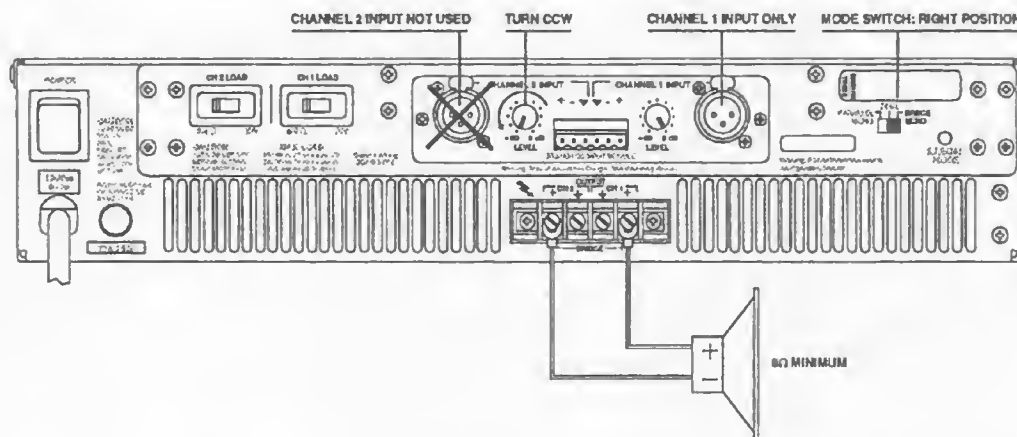
Figure 2b Parallel Mono Connections

Parallel Mono - This configuration provides the means to increase the current delivered to a single speaker load by shorting the outputs together (Figure 2b). Both channels are combined to create one power amplifier that has the equivalent power capacity of both channels. Do not make the mistake however of assuming that for example, an AP2400 in parallel mono mode driving a single 8-ohm load will deliver 400 watts. It will still deliver 200 watts with a 0 dBu input signal. The advantage of parallel mono is the ability to double the power into a 4-ohm load (400 watts) as well as deliver still more power into 2 ohms (500 watts) without overheating or current limiting. For distributed 70-volt line applications, parallel mono mode allows loading the amplifier for the full rated power of both channels on a single 70-volt line. The signal source is connected to the channel-one input only. The channel-2 input is disabled.

WARNING: The load switches must be set in tandem when operating in parallel mono mode. If one load switch is set for 70-volt and the other is set for 8/4 ohms while in this mode, the protection logic will disable channel one. See "ILLEGAL MODE" for more information.



Figure 2c Bridged Mono Connections



CAUTION: Unlike the other modes where the speaker load has one terminal connected to ground, bridged mono mode provides a differential "floating" signal to the speaker load and therefore any test equipment that is used to measure this signal should also have a floating ground.

WARNING: The load switches must be set in tandem when operating in bridged mono mode. If one load switch is set for 70-volt while the other is set for 8/4 ohms while in this mode, the protection logic will disable channel one. See "ILLEGAL MODE PROTECTION" for more information.

Bridged Mono - In this mode a single speaker load is connected across the amplifier outputs (Figure 2c). For proper operation the signal source is connected to the channel-one input. The channel-two input level should be fully counterclockwise. In this mode the amplifier is providing a true balanced output.

For 8/4-ohm load configuration, the load impedance should not be less than 8 ohms. A 70-volt load configuration in bridged mono mode allows driving a 100-volt distributed system* or a 140-volt system.

**input sensitivity must be adjusted to -3 dBu (0.549 V rms)*

ILLEGAL MODE PROTECTION

Illegal mode protection is provided to guard against an improper mono-mode setting. When the amplifier is set in either bridged or parallel mono, both amplifiers are combined as one power stage to drive the speaker load. It is necessary that each amplifier's load switch is configured identically since both amplifiers are driving the same load. To avoid problems, the protection logic will sense an improper condition and disable channel one. Channel two is also disabled since channel two is driven by channel one. The channel 1 Standby LED on the front panel will turn on. In addition the "ILLEGAL MODE" LED on the rear panel will also turn on. The amplifier will remain in this mode until both load switches are identically set, or dual mode is selected.

70 VOLT OPERATION

70-volt line operation provides a means to drive multiple sets of speakers without the confusion and complexity of adjusting the final load impedance. The term 70-volt refers to the output rms voltage delivered by the amplifier. By comparison, the output voltage for an AP2400 into an 8-ohm load with an input of 0 dBu is 40 volts rms. When the amplifier load switch is changed to the 70-volt position, two things happen. One is that the gain is increased so that an input of 0 dBu results in an output of 70.7 volts rms. The second is that the amplifier power supply voltage is adjusted to accommodate this output level.

This type of system requires a speaker that includes a small power converting transformer. Each speaker is rated not by its load impedance but by the power that it consumes from the amplifier. For example, if you have speakers that have a 70-volt rating of 10-watts each then you can parallel twenty of these speakers to each channel of an AP2400 amplifier. The total power is evenly distributed among each speaker. Even if several speakers are disconnected from the line, the remaining speakers will still only consume 10 watts each. The power can also be unevenly distributed. For example five 20-watt speakers can be paralleled with ten 10-watt speakers as long as the total power does not exceed that of the amplifier that is driving the 70-volt line. In this case each 20 watt speaker will be 3 dB louder than the 10 watt speakers. The relatively high impedance of a 70-volt line allows longer cable runs to remote speakers (see "OUTPUT CABLE SELECTION", "CALCULATING POWER LOSSES" and "DAMPING FACTOR" for more details on the affects of cable length on a speaker system). Any amplifier that drives a 70-volt line must be capable of providing an output of 200 volts peak to peak. This is why many amplifiers require expensive step-up transformers. The AP2000 series can drive the 70-volt line direct without using step-up transformers. A 140-volt system can be directly driven using the bridged mono mode. A 100-volt system can be driven if the input signal is reduced to -3 dBu (0.549 V rms). A 100-volt system would require speakers that are designed with transformers that have a 100-volt input tap. Likewise a 140-volt system would require speakers that are designed with transformers that have a 140-volt input tap.

WARNING: Do not use the 70-volt position as a method for increasing gain to a low impedance load. When the supply voltage is increased for 70-volt operation, there must be a corresponding increase in the load impedance. Otherwise the resulting high voltage and increased current will cause the amplifier to overheat and shut down.

INSTALLATION

The amplifier may be installed in a standard 19 inch equipment rack. The AP2200 & AP2400 requires 89 mm (3.5 in.) of vertical rack space and 406.4 mm (16 in.) of depth. The amplifiers secure to the rack cabinet with four rack mount screws and cup washers provided in the hardware kit.

VENTILATION

The amplifier must be adequately ventilated to avoid excessive temperature rise. The air is drawn from front to back therefore a rear ventilated cabinet should be used. It should not be used in areas where the ambient temperature exceeds 60° C (140° F). To determine the ambient air temperature, operate the system in the rack until the temperature stabilizes. Measure the ambient air with a bulb-type thermometer held at the bottom of the uppermost amplifier. Do not let the thermometer touch the metal chassis because the chassis will be hotter than the ambient air. If the air temperature exceeds 60° C (140° F), the equipment should be spaced at least 44 mm (1.75 in.) apart or a blower installed to provide sufficient air movement within the cabinet.

OUTPUT CABLE SELECTION

Speaker wire size plays an important part in quality sound systems. Small wire gauges can waste power and reduce the damping factor at the speaker terminals. This can add coloration and muddiness to the sound. To help offset this problem Tables I and II have been assembled to enable you to calculate the power losses in the speaker cable.

WARNING: Do not operate the amplifier within a completely closed unventilated housing.



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CALCULATING POWER LOSSES

To calculate the total power loss in the speaker cable, multiply the power loss per foot of the 2-wire cable using the appropriate table below by the length of the cable in feet. For example, suppose an installer uses 160 feet of 12 gauge 2-wire cable with an 8-ohm speaker system connected to an AP2200 amplifier. The total power loss in the cable is:

$$\text{Total Power Loss} = 0.0405 \text{ watts/foot} \times 160 \text{ feet} = 6.5 \text{ watts}$$

Does this mean that whenever the amplifier produces 100 watts of output power, 93.5 watts (100 watts minus 6.5 watts) will be delivered to the 8 ohm load? NO! The actual load impedance is 8 ohms plus the resistance of the cable ($0.00324 \times 160 \text{ feet} + 8 = 8.52 \text{ ohms}$). Because of the change in the load impedance, the actual total power produced by the amplifier is 93.9 watts. The power delivered to the load is approximately 93.9 watts minus 6.5 watts or 87.4 watts.

TABLE I AP2200 Power Losses per foot in 2-wire Speaker Cable

| Ω AWG | 2 (300W)* | 4 (150W) 8 (300W)** | 8 (100W) | 16 (50W) | 70V(100W) 140V(200W)** |
|-----------------|-----------|------------------------|----------|----------|---------------------------|
| 6 | 0.1214 | 0.0303 | 0.0101 | 0.0025 | 0.0016 |
| 8 | 0.1813 | 0.0453 | 0.0151 | 0.0038 | 0.0024 |
| 10 | 0.3054 | 0.0764 | 0.0255 | 0.0064 | 0.0041 |
| 12 | 0.4844 | 0.1213 | 0.0405 | 0.0101 | 0.0065 |
| 14 | 0.7685 | 0.1926 | 0.0643 | 0.0161 | 0.0103 |
| 18 | 1.2185 | 0.3058 | 0.1022 | 0.0256 | 0.0164 |
| 18 | 1.9278 | 0.4851 | 0.1622 | 0.0406 | 0.0260 |
| 20 | 3.0417 | 0.7682 | 0.2574 | 0.0645 | 0.0414 |
| 22 | 4.7794 | 1.2144 | 0.4081 | 0.1025 | 0.0658 |

* Parallel Mono **Bridged Mono

TABLE II AP2400 Power Losses per foot in 2-wire Speaker Cable

| Ω AWG | 2 (500W)* | 4 (250W) 8 (500W)** | 8 (200W) | 16 (100W) | 70V(200W) 140V(400W)** |
|-----------------|-----------|------------------------|----------|-----------|---------------------------|
| 6 | 0.2023 | 0.0506 | 0.0202 | 0.0051 | 0.0065 |
| 8 | 0.3021 | 0.0756 | 0.0302 | 0.0076 | 0.0097 |
| 10 | 0.5090 | 0.1274 | 0.0510 | 0.0127 | 0.0163 |
| 12 | 0.8074 | 0.2022 | 0.0809 | 0.0202 | 0.0235 |
| 14 | 1.2809 | 0.3211 | 0.1286 | 0.0322 | 0.0412 |
| 16 | 2.0308 | 0.5098 | 0.2043 | 0.0511 | 0.0655 |
| 18 | 3.2130 | 0.8085 | 0.3244 | 0.0812 | 0.1041 |
| 20 | 5.0695 | 1.2805 | 0.5148 | 0.1290 | 0.1653 |
| 22 | 7.9656 | 2.0240 | 0.8163 | 0.2049 | 0.2627 |

* Parallel Mono **Bridged Mono

DAMPING FACTOR

The higher the damping factor of an amplifier, the greater the ability of the amplifier to control unwanted speaker cone movements. When a signal drives a woofer, current flowing through the voice coil creates a magnetic field. This field interacts with the permanent magnetic field in the gap and forces the combination cone and voice coil assembly to move outward. When the signal is removed, the assembly moves inward but its momentum causes it to overshoot its resting point. This overshoot will dampen itself out eventually but the unwanted movements can add considerable distortion to the sound. In the process of moving inward through the magnetic field, the voice coil assembly generates a current of opposite polarity to the original signal. This current induces a voltage or "back EMF" which travels through the speaker wire to the amplifier's output. The lower the amplifier source impedance, the faster the overshoot of the voice coil will dampen out. The source impedance of an amplifier can be calculated by dividing the rated output impedance, typically 8 ohms, by the damping factor. The source impedance of the AP2200 and the AP2400 is 0.032 ohms.

Cable Selection for Specified Damping Factor at the Load.

The damping factor rating of the amplifier is typically never realized at the load because of the resistance of the cable. The damping factor at the load should be 30 for general paging systems and 50 for high-fidelity music systems. Economics usually dictate however that these numbers are cut in half. The resulting damping factor at the load should be based on experience and customer satisfaction. Once a minimum damping factor is determined for a particular type of installation, the following equation can be used to calculate the maximum length of two-wire cable which can be used to achieve the minimum damping factor specified at the load:

$$\text{Max Length} = \frac{\frac{Z_L}{DF} - Z_o}{DCR}$$

Z_L = load impedance

Z_o = Amplifier source impedance

DF = minimum permissible damping factor

DCR = dc resistance per foot of the 2-wire cable (Table III)

For 70-volt systems Z_L can be approximated as:

$$Z_L = 70.7^2 / P_{out}$$

P_{out} = Amplifier rated power

For 100-volt systems $Z_L = 100^2 / P_{out}$

For 140-volt systems $Z_L = 141.4^2 / P_{out}$

Suppose Z_L equals 8 ohms, $Z_o = 0.032$ ohms (AP2400) and the minimum damping factor at the load is to be 25. In addition, 18 GA cable is preferred. Then the maximum length of cable which can be used to achieve a damping factor of 25 at the load is:

$$\text{Max Length} = ((8/25) - 0.032) / 0.01302 = 22.1 \text{ feet}$$

Suppose you would like to calculate the maximum length of 2-wire cable using the same conditions as above except now you are using a 70V system instead of an 8 ohm system. For a 200 watt 70-volt system, $Z_L = 70.7^2 / 200 = 25$ ohms. Using the above calculation for a minimum DF of 25:

$$\text{Max Length} = ((25/25) - 0.032) / 0.01302 = 74.3 \text{ feet}$$

A 140-volt 200 watt system using the same conditions as above would allow over 298 feet of 18 gauge cable. Note that in each case, the total power loss in the

TABLE III

| AWG | DCR (Ω /ft) | DCR (Ω /m) |
|-----|---------------------|--------------------|
| 6 | 0.00081 | 0.00264 |
| 8 | 0.00121 | 0.00421 |
| 10 | 0.00204 | 0.00669 |
| 12 | 0.00324 | 0.01063 |
| 14 | 0.00515 | 0.01691 |
| 16 | 0.00819 | 0.02685 |
| 18 | 0.01302 | 0.04289 |
| 20 | 0.02070 | 0.06764 |
| 22 | 0.03292 | 0.10658 |



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cable is roughly the same (between 7 and 8 watts) even though the cable length was extended from 22.1 to 298 feet! This illustrates the advantage of high-voltage systems for distributed sound.

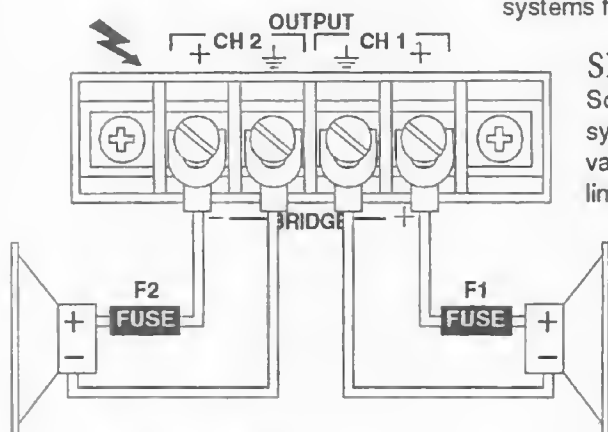


Figure 3a Optional protection fuse connection

SPEAKER PROTECTION

Sometimes it may be desirable to use in-line fuses to protect loudspeaker systems (Figure 3a). It is difficult however to determine the proper fuse value with the correct time lag and overload characteristics to match the limitations of a speaker system. Fuse values are shown for the given power and load in Table IV. The values are calculated for fast-blow fuses which carry 135% of their current rating for an hour but will blow within 1 second at 200%. Other fuse values may be calculated for different power levels from the following equation:

$$\text{Fuse Value} = \frac{\sqrt{P_{out} \cdot ZL}}{ZL \cdot 1.35}$$

P_{out} = rated power of amplifier

ZL = load impedance

TABLE IV Speaker Protection Fuse Chart

| Power (Watts) | 4Ω | 8Ω | 16Ω |
|---------------|------|------|------|
| 100 | 3.70 | 2.62 | 1.85 |
| 150 | 4.54 | 3.21 | 2.27 |
| 200 | 5.24 | 3.70 | 2.62 |
| 300 | 6.42 | 4.54 | 3.21 |
| 400 | 7.41 | 5.24 | 3.70 |
| 600 | 9.07 | 6.42 | 4.54 |

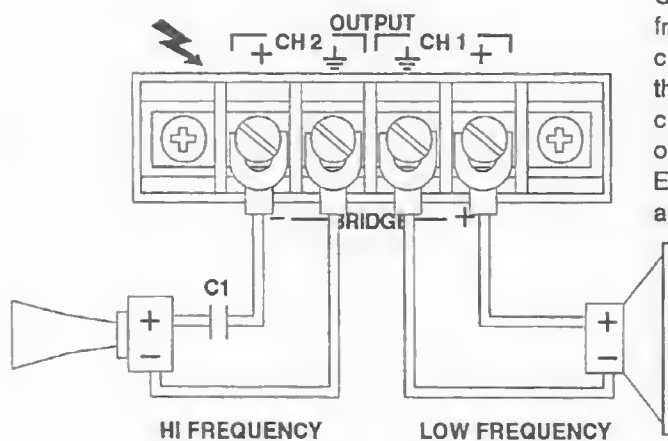


Figure 3b BIAMP connection with compression driver protection capacitor

Compression drivers are much more susceptible to damage from low frequencies than large cone loud-speakers. Even though an electronic crossover may be employed, problems may arise in the cables between the crossover and the power amplifier, or from misadjustment of the crossover. Either of these situations could apply low frequency signals or hum to the driver and cause damage. To prevent a potential problem, Electro-Voice® recommends using a capacitor between the amplifier and the compression driver to suppress low frequencies and possible dc. Refer to the example in Figure 3b.

In choosing a value, one must be careful not to interfere with the crossover frequency. As a general rule, select a capacitor whose break frequency with respect to the load is 3 dB down at approximately 1/2 of the high pass corner frequency. Mylar capacitors with at least a 100 volt ac rating are recommended. Table V shows the recommended capacitor values for use with 8 and 16-ohm drivers at common crossover frequencies.

TABLE V. Protection Capacitor Sizes for Common Cross-Over Frequencies

| X-over Freq | 8 Ohm | 16 Ohm |
|-------------|-------|--------|
| 500 HZ | 80 uF | 40 uF |
| 800 HZ | 50 uF | 25 uF |
| 1000 HZ | 40 uF | 20 uF |
| 1250 HZ | 33 uF | 16 uF |
| 2000 HZ | 20 uF | 10 uF |
| 3150 HZ | 12 uF | 6 uF |
| 6300 HZ | 6 uF | 3 uF |



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SERVICE INSTRUCTIONS

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Notice: Modifications to Electro-Voice® products are not recommended. Such modifications shall be at the sole expense of the person(s) or company responsible, and any damage resulting therefrom shall not be covered under warranty or otherwise.

Note: If you need to verify the performance of the amplifier against the rated specifications, you must be able to maintain the ac line voltage constant at 120 V ac. Therefore, we recommend a suitably rated variac (50 ampere rating at 120 V ac).

DC OFFSET TRIM PROCEDURE

The following adjustments are best performed after the amplifier has warmed up. First remove the top cover by the 6 access screws along the front and back (Figure 4). Refer to figure 5 for the following procedure.

1. With the amplifier in dual mode, turned on and no signal, locate trim pot R7 on the Driver PCB
2. Adjust for an output of zero volts dc, +/- 1 mV, measured at the channel-1 output speaker terminals.
3. Repeat step 2 adjusting R26, measured at the channel-2 output speaker terminals.

IDLE CURRENT TRIM PROCEDURE

The following adjustments are made on the main power amplifier board. This board can be exposed by removing the four access screws at the four corners on the rear panel and raising the driver board assembly (Figure 4). Each channel is a grounded bridge configuration. Since a grounded bridge consists of 2 amplifier stages for each output, there are 2 independent Idle adjustments for each channel. One is for the high side amplifier that drives the positive output terminal and the other is for the low side amplifier which sinks or sources the return path (ground terminal). Refer to Figure 6 for the following procedures.

1. The Channel-1 high side bias is adjusted with R102 for a dc voltage measure of 5 mV, +/- 0.1 mV across the outside legs of R108.
2. The Channel-1 low side bias is adjusted with R125 for a dc voltage measure of 5 mV, +/- 0.1 mV across the outside legs of R122.
3. The Channel-2 high side bias is adjusted with R202 for a dc voltage measure of 5 mV, +/- 0.1 mV across the outside legs of R208.
4. The Channel-2 low side bias is adjusted with R225 for a dc voltage measure of 5 mV, +/- 0.1 mV across the outside legs of R222.

NOTICE: Repairs performed by other than authorized warranty stations (Dealers) or qualified personnel shall void the warranty period of this unit. To avoid loss of warranty, see your nearest Electro-Voice® authorized dealer, or call Mark IV Audio Service directly at 1-800-234-6831, or FAX (616) 695-4743 or write:

Mark IV Audio Service
600 Cecil Street
Buchanan, MI 49107
USA

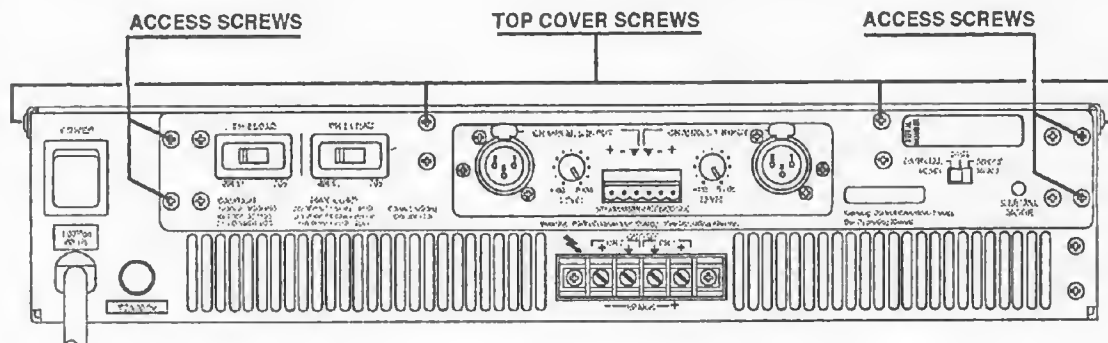


Figure 4 Access screws

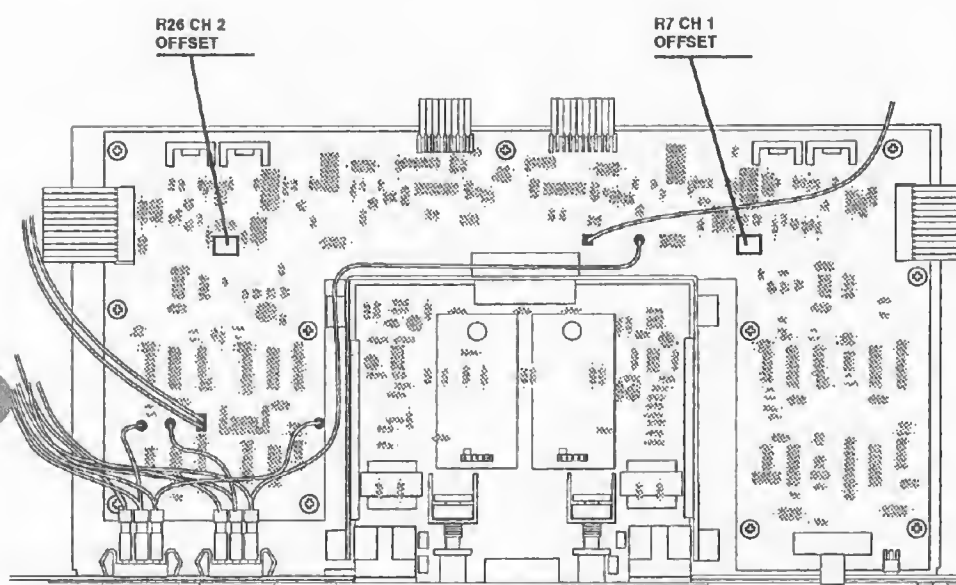


Figure 5 DC bias trim pot locations

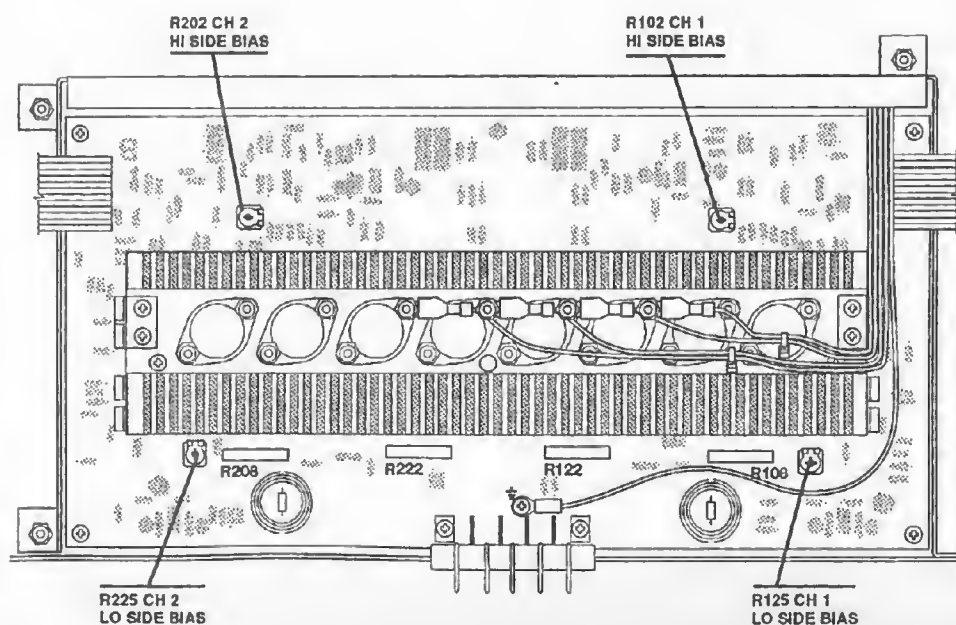
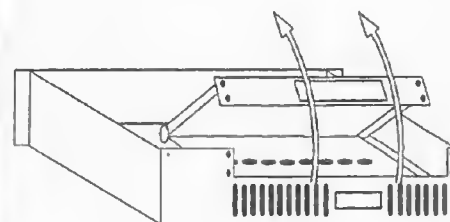


Figure 6 Idle current trim pot locations





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AP2200 & AP2400 COMPONENT PARTS LIST

ORDERING REPLACEMENT PARTS

To order replacement parts, look up the ordering part number from the component parts listing and call 1-800-234-6831 or Fax 616-695-4743

| REFERENCE | PART NUMBER | DESCRIPTION |
|---|--------------|-------------------------------|
| PCB POWER AMPLIFIER (27-01-050994) | | |
| SEMICONDUCTORS | | |
| U101,201 | 17-01-039252 | NE5534AN Low noise op amp |
| U100,200 | 17-01-124462 | TL071CP Single Op Amp |
| D100,101,200,201 | 48-01-122601 | 1N4448 Diode |
| D102-107,113,115 | 48-01-125067 | 1N4937 Diode |
| D202-207,213,215 | 48-01-125067 | 1N4937 Diode |
| D108-112,114 | 48-02-042787 | 1N4004 Diode |
| D208-212,214 | 48-02-042787 | 1N4004 Diode |
| U102,202 | 48-03-039392 | LM35DZ Temp sensor |
| Q100,200 | 48-03-039704 | MPSA18 NPN transistor |
| Q111,211 | 48-03-039705 | MJE340 NPN driver transistor |
| Q112,212 | 48-03-039706 | MJE350 PNP driver transistor |
| Q101,201 | 48-03-107102 | 2N3906 PNP transistor |
| Q102,202 | 48-03-121306 | 2N3904 NPN transistor |
| Q105,107,205,207 | 48-03-122978 | MJ15024 NPN Power transistor |
| Q106,108,206,208 | 48-03-122979 | MJ15025 PNP Power transistor |
| Q104,110,204,210 | 48-03-051553 | 2SA1668 PNP Driver Transistor |
| Q103,109,203,209 | 48-03-051554 | 2SC4382 NPN Driver Transistor |
| RESISTORS | | |
| R113,114,120,121 | 47-01-039747 | 2.7 Ohm 1W 5% Flameproof |
| R213,214,220,221 | 47-01-039747 | 2.7 Ohm 1W 5% Flameproof |
| R105,110,205,210 | 47-03-124676 | 1.21 k .25W/1% |
| R101,201 | 47-03-122868 | 1.33k .25W/1% |
| R128,129,228,229 | 47-01-102088 | 2.7k .25W/5% |
| R127,227,139,140 | 47-01-039390 | 200 Ohm .5W/5% |
| R239,240 | 47-01-039390 | 200 Ohm .5W/5% |
| R106,109,206,209 | 47-01-102298 | 27k .5W/5% |
| R118,218 | 47-03-028226 | 66.5k .25W/1% |
| R134,234 | 47-03-037660 | 3.32k .25W/1% |
| R136,236 | 47-03-037662 | 3.65 k .25W/1% |
| R133,233 | 47-03-039391 | 33.2k .5W/1% |
| R135,138,235,238 | 47-03-051175 | 36.5k .5W 1% |
| R107,207 | 47-03-121457 | 110k .25W/1% |
| R119,126,130,219 | 47-03-109437 | 10K .25W 1% |
| R226,230 | 47-03-109437 | 10K .25W 1% |
| R103,111,116,131 | 47-03-121532 | 1K .25W 1% |
| R132,137 | 47-03-121532 | 1K .25W 1% |
| R203,211,216,231 | 47-03-121532 | 1K .25W 1% |
| R232,237 | 47-03-121532 | 1K .25W 1% |

| REFERENCE | PART NUMBER | DESCRIPTION |
|----------------------------------|--------------|------------------------------|
| R104,112,123,124 | 47-01-051289 | 100 Ohm 1W / 5% Flame P |
| R204,212,223,224 | 47-01-051289 | 100 Ohm 1W / 5% Flame P |
| R100,200 | 47-03-124697 | 3.24k .25W/1% |
| R117,217 | 47-03-124648 | 1.78k .25W/1% |
| R102,125,202,225 | 47-06-125036 | 250 Ohm Trim |
| R108,122,208,222 | 47-09-125029 | .22 X 2 5% 5W Ceramic |
| W01-70 | 21-01-110310 | Jmpr Circuit |
| CAPACITORS | | |
| C100,101,200,201 | 15-06-124587 | .001uF 100V poly |
| C103,203 | 15-01-124503 | 100uF/50V Alum Elec |
| C107,108,207,208 | 15-02-100018 | 47pF 100V ceramic |
| C109,112,209,212 | 15-02-106367 | 68pF 200V |
| C110,210 | 15-02-107532 | 330pF 200V ceramic |
| C102,202 | 15-06-038149 | 0.022uF 100V Metallized Poly |
| C105,106,205,206 | 15-06-039383 | 0.1uF 400V Metallized Poly |
| C104,111,113,115 | 15-02-122891 | 0.1uF 50V Ceramic Radial |
| C118,120 | 15-02-122891 | 0.1uF 50V Ceramic Radial |
| C204,211,213,215 | 15-02-122891 | 0.1uF 50V Ceramic Radial |
| C218,220 | 15-02-122891 | 0.1uF 50V Ceramic Radial |
| C114,116,119,121 | 15-01-028691 | 10uF/50V Alum El |
| C216,219,221 | 15-01-028691 | 10uF/50V Alum El |
| CONNECTORS | | |
| J100,200 | 21-01-051176 | Header, 12 connector 0.1in |
| | 21-03-050992 | Term .25in Spade, screw mnt |
| J103 | 21-04-050969 | Barr Strip 4 Term PC Mount |
| HARDWARE | | |
| TO220 driver mntg | 28-01-124701 | Screw # 4x1/4" ROL PHP BO |
| TO220 driver mntg | 14-08-051177 | Bracket, L |
| TO220 driver mntg | 28-04-125012 | Wshr Nylon shoulder |
| TO3 & Term mntg | 28-02-114116 | Nut, keps 6-32 |
| Term strip mntg | 28-01-113868 | SCREW 6-32 x 5/16 PHP STL |
| TO3 mounting | 28-01-115520 | SCREW 6-32 x 5/8 PHP |
| TO3 mounting | 28-07-051174 | Nylon spacer |
| TO3 mounting | 28-03-103639 | WSHR #6 Inside star |
| MISCELLANEOUS | | |
| L100,200 | 56-01-039697 | Inductor 1.85 uH |
| | 14-05-050993 | Heatsink Extruded/Cross Flow |
| | 31-02-124568 | Insulators TO-3 |
| PCB DRIVER (27-01-051145) | | |
| SEMICONDUCTORS | | |
| U5,6,11,12 | 17-01-124463 | LM339N Quad Comparator |
| U3,4,9,10 | 17-01-029028 | LM324 Low Pwr Quad Op Amp |
| U1,U7 | 17-01-124461 | TLO74CN Quad Op Amp |
| U2,U8 | 17-01-124462 | TLO71CP Single OP Amp |
| Q30 | 48-03-121306 | 2N3904 NPN transistor |
| Q13 | 48-03-027336 | TIP 32 PNP transistor |
| Q5,6,8,9,11,12,16 | 48-03-039707 | MPSA42 NPN transistor |
| Q20,25,26,28,29 | 48-03-039707 | MPSA42 NPN transistor |
| Q1,3,17,21,24,27 | 48-03-039708 | MPSA92 PNP transistor |
| O7,10,18,22 | 48-03-039705 | MJE340 NPN driver transistor |
| O2,4,15,19 | 48-03-039706 | MJE350 PNP driver transistor |
| LED1 illegal mode | 39-01-051184 | LED Amber |
| CR2,3,5,6,24,36 | 48-02-042787 | 1N4004 Diode |
| CR29,30,31,32 | 48-01-125067 | 1N4937 Diode |

| REFERENCE | PART NUMBER | DESCRIPTION |
|--------------------------------------|-------------------------|-----------------------|
| CR7,33 | 48-01-124431 | 1N5359 24V Zener / 5W |
| CR1,4,8-23,25-28 | 48-01-122601 | 1N4448 Diode |
| CR34,35,37-48 | 48-01-122601 | 1N4448 Diode |
| 1/8 WATT METAL FILM RESISTORS | | |
| R4,9,24,28 | 47-01-051211 | 47.5 Ohm .125W 1% |
| R11,32 | 47-01-051210 | 330 Ohm .125W 5% |
| R165,170,172,176 | 47-01-051209 | 560 Ohm .125W 5% |
| R1,2,3,21,22,23 | 47-03-051222 | 1.00 k Ohm .125W 1% |
| R46,54,78,81,89 | 47-03-051222 | 1.00 k Ohm .125W 1% |
| R124,126,127,134 | 47-03-051222 | 1.00 k Ohm .125W 1% |
| R138,139,140,143 | 47-03-051222 | 1.00 k Ohm .125W 1% |
| R144,145,148,149 | 47-03-051222 | 1.00 k Ohm .125W 1% |
| R150,160,200,201 | 47-03-051222 | 1.00 k Ohm .125W 1% |
| R8,27,121,123 | 47-03-051221 | 1.10 k Ohm .125W 1% |
| R153,155 | 47-03-051221 | 1.10 k Ohm .125W 1% |
| R49,76,84,116 | 47-01-051208 | 1.5 k Ohm .125W 5% |
| R164,169,171,175 | 47-01-051208 | 1.5 k Ohm .125W 5% |
| R125,137,142,147 | 47-03-051219 | 2.0 k Ohm .125W 1% |
| R42,77 | 47-03-051198 | 2.43 k Ohm .125W 1% |
| R41,70,71,110,111 | 47-01-051207 | 3.9 k Ohm .125W 5% |
| R17,20,40,72 | 47-01-051206 | 4.7 k Ohm .125W 5% |
| R112,191,193 | 47-01-051206 | 4.7 k Ohm .125W 5% |
| R195,197 | 47-01-051206 | 4.7 k Ohm .125W 5% |
| R128,151 | 47-03-051311 | 9.31 k Ohm .125W 1% |
| R14,18,30,37,38 | 47-03-051218 | 10.0 k Ohm .125W 1% |
| R48,52,56,62,65 | 47-03-051218 | 10.0 k Ohm .125W 1% |
| R66,69,75,83,87 | 47-03-051218 | 10.0 k Ohm .125W 1% |
| R91,95,96,100,105 | 47-03-051218 | 10.0 k Ohm .125W 1% |
| R106,109,115,117 | 47-03-051218 | 10.0 k Ohm .125W 1% |
| R119,132,133,158 | 47-03-051218 | 10.0 k Ohm .125W 1% |
| R166,167,168,173 | 47-03-051218 | 10.0 k Ohm .125W 1% |
| R174,180,181,183 | 47-03-051218 | 10.0 k Ohm .125W 1% |
| R184,185,186,187 | 47-03-051218 | 10.0 k Ohm .125W 1% |
| R188,189 | 47-03-051218 | 10.0 k Ohm .125W 1% |
| R44,79,136,163 | 47-03-051217 | 20.0 k Ohm .125W 1% |
| R58,93 | 47-01-051205 | 27 k Ohm .125W 5% |
| R47,82 | 47-01-051204 | 30 k Ohm .125W 5% |
| R57,59,92,101 | 47-01-051203 | 36 k Ohm .125W 5% |
| R19,39 | 47-03-051190 | 40.2 k Ohm .125W 1% |
| R94 | 47-03-051189 | 41.2 k Ohm .125W 1% |
| R97 | 47-03-051224 | 90.9 k Ohm .125W 1% |
| R53,55,88,90,122 | 47-03-051215 | 100 k Ohm .125W 1% |
| R131,154,159,177 | 47-03-051215 | 100 k Ohm .125W 1% |
| R178,190,192,194 | 47-03-051215 | 100 k Ohm .125W 1% |
| R196,198 | 47-03-051215 | 100 k Ohm .125W 1% |
| R61,67,99,104,107 | 47-03-051213 | 121 k Ohm .125W 1% |
| R182 | 47-03-051213 | 121 k Ohm .125W 1% |
| R50,63,64,73,85 | 47-01-051202 | 470 k Ohm .125W 5% |
| R102,103,113 | 47-01-051202 | 470 k Ohm .125W 5% |
| R51,86 | 47-01-051201 | 1.0 M Ohm .125W 5% |
| R45,60,68,80,98,108 | 47-01-051200 | 2.0 M Ohm .125W 5% |
| R74,114 | 47-01-051199 | 2.7 M Ohm .125W 5% |
| R114 | 47-01-051199 | 2.7 M Ohm .125W 5% |
| R120,152 | See table in schematics | |

| REFERENCE | PART NUMBER | DESCRIPTION |
|---------------------------------|-------------------------|-----------------------------|
| R129,156 | See table in schematics | |
| R130,157 | See table in schematics | |
| R141,146 | See table in schematics | |
| MISCELLANEOUS RESISTORS | | |
| R5,25 | 47-01-039390 | 200 Ohm .5W 5% |
| R199 | 47-01-028008 | 2.7k Ohm .5W 5% CF |
| R6,29,135,161,162 | 47-03-051212 | 20 k Ohm .5W 1% MF |
| R118,179 | 47-01-051310 | 1.5k Ohm 1W 5% |
| R7,26 | 47-06-121916 | POT trim 2 k Ohm .5 Watt |
| CAPACITORS | | |
| C40,41,44,45 | 15-02-100014 | 15 pF Ceramic 500V |
| C1,2,3,5,27,34 | 15-02-100018 | 47 pF/ 200V Ceramic |
| C65,66,69,70 | 15-02-100018 | 47 pF/ 200V Ceramic |
| C30,38,57-60 | 15-02-100024 | 100pF/ 200V Ceramic |
| C55,56 | 15-02-102603 | 120pF/ 200V Ceramic |
| C61-64 | 15-02-100042 | .001uF Ceramic |
| C10,18 | 15-06-124691 | .0033uF 50V Ceramic |
| C11,19 | 15-06-027395 | 0.01uF 50V Ceramic |
| C4,6,7,8,9,15,16 | 15-02-124808 | 0.1uF 50V Ceramic |
| C17,21,24,26,33 | 15-02-124808 | 0.1uF 50V Ceramic |
| C35,47,48,49,50 | 15-02-124808 | 0.1uF 50V Ceramic |
| C51-54,72 | 15-02-124808 | 0.1uF 50V Ceramic |
| C39,42,43,46 | 15-06-039383 | .1uF 400V Met Poly |
| C20,71 | 15-06-122843 | 0.33uF 50V Ceramic |
| C14,22 | 15-01-124509 | 2.2uF 50V Electrolytic |
| C23,25,31,32 | 15-01-028691 | 10uF 50V Electrolytic |
| C28,36 | 15-01-125026 | 6.8 uF non-pol Electrolytic |
| C67,68 | 15-01-124508 | 47uF 50V Electrolytic |
| C29,37 | 15-01-102611 | 220uF 16V Electrolytic |
| CONNECTORS | | |
| P1 | 21-02-050973 | 30 Pin connector female |
| J1 | 21-01-124829 | 8 pin Header 0.1" ctrs |
| J2 | 21-02-123239 | 10 pin Header 0.1" ctrs |
| J3 | 21-01-123198 | 2 Pin Header 0.1" ctrs |
| J100A,200A | 21-01-051176 | 12 pin Header 0.1" ctrs |
| HARDWARE | | |
| | 28-07-051187 | Standoff, LED Rt Angle |
| T0220 hardware | 28-01-124701 | Screw #4 x 1/4" ROL PHP BO |
| Drvtr xtr hardware | 28-02-027389 | Nut Keps Hex 4-40 |
| Drvtr xtr hardware | 28-01-026899 | Screw MCH 4-40 |
| MISCELLANEOUS | | |
| K1, K2 | 45-01-051144 | 5V Relay DPDT |
| S1 | 51-02-050968 | Switch 6P3T |
| | 14-05-045222 | Htsk Stamped Short |
| | 14-05-027783 | Htsk Stamped tall |
| L1, L2 | 56-01-121543 | 2.7 mH |
| PCB INPUT (27-01-039770) | | |
| SEMICONDUCTORS | | |
| U1,2 | 17-01-122832 | 5532A Low noise op amp |
| RESISTORS | | |
| R7,8,16,17 | 47-03-121532 | 1.0k .25 W1% |
| R1,2,3,4,10,11,12 | 47-03-109437 | 10k .25W 1% |
| R13 | 47-03-109437 | 10k .25W 1% |
| R6,15 | 47-03-028260 | 47.5 k .25W 1% |



Electro-Voice®

Operation Manual for the
AP2200 & AP2400 amplifiers

| REFERENCE | PART NUMBER | DESCRIPTION |
|------------|--------------|-------------------------|
| R9,18 | 47-03-037770 | 100 .25 W 1% |
| JMP1-4,7,8 | 21-01-110310 | JMPR CIRCUIT |
| W01-20 | 21-01-110310 | JMPR CIRCUIT |
| R5,14 | 47-06-039484 | 3k detent potentiometer |
| | 24-04-124526 | Knob Screwdriver adjust |

CONNECTORS

| | | |
|---------|--------------|------------------------------|
| J2A,J4A | 21-01-037785 | XLR Connector pc mount |
| J3 | 1170FJ0003 | 3 conductor Header Rt-angle |
| | 1170FJ0008 | 3 conductor terminal Plug-In |
| J1A | 21-01-050972 | 30 pin Header .1" ctrs |
| J5,8 | 21-03-122968 | 5 pin Header .1" ctrs |
| | 1170-JA-0001 | 2 pos shorting jmp. .1" cntr |
| J7 | 21-01-051178 | 3 pin Header .1" cntr |

CAPACITORS

| | | |
|-----------------|--------------|-----------------------------|
| C5,15 | 15-01-125026 | 6.8 uF non-pol Electrolytic |
| C4,13,8,17 | 15-02-124808 | .1uF 50V Ceramic |
| C6,16 | 15-06-124587 | .001 uF 50V Poly |
| C1,11 | 15-02-029032 | 15pF 50V Ceramic |
| C10,18,20,21 | 15-01-028691 | 10uF 50V Electrolytic |
| C2,3,7,12,14,19 | 15-02-028578 | 47pF 50V Ceramic |

MISCELLANEOUS

| | | |
|--------------|--------------|--------------------------|
| FL1,2,3,4 | 56-01-050483 | Ferrite Bead, EMC Filter |
| XLR PCB mntg | 28-01-124701 | Screw 4-40x1/4 |

PCB DISPLAY (27-01-051167)

SEMICONDUCTORS

| | | |
|--------------|--------------|-----------------------|
| Q1,2,3,4,5,6 | 48-03-121306 | 2N3904 NPN Transistor |
| D1,5,6 | 39-01-051185 | LED Red |
| D3,8 | 39-01-051186 | LED Green |
| D2,7 | 39-01-051184 | LED Amber |
| D4,9 | 48-02-042787 | 1N4004 Diode |

RESISTORS

| | | |
|------------------|--------------|--------------|
| R1,8,14,15 | 47-03-109437 | 10k .25W 1% |
| R2,3,5,7,9,10,12 | 47-03-121532 | 1k .25W 1% |
| R4,11 | 47-03-028173 | 100k .25W 1% |
| R6,13 | 47-03-051212 | 20k .5W 1% |
| MF W01 | 21-01-110310 | Jmpr Circuit |

MISCELLANEOUS

| | | |
|-------------|--------------|-----------------------|
| J1A | 21-01-051372 | 8 pin Header .1" ctrs |
| LED spacers | 28-07-051183 | Spacers, perm-o-pads |

PCB SUPPLY AP2200 (27-01-051148)

SEMICONDUCTORS

| | | |
|------------|--------------|------------------------------|
| U1, U2 | 17-02-039512 | MOC3041 Opto-Triac |
| U3 | 17-01-051179 | LM7806 6 volt regulator |
| U4 | 17-01-121660 | LM7815 15 volt regulator |
| U5 | 17-01-121659 | LM7915 neg 15 volt regulator |
| CR1A-CR1D | 48-02-051000 | Diode 6 emp 200V / AP2200 |
| CR2A-CR2D | 48-02-051000 | Diode 6 emp 200V / AP2200 |
| D1,2,3,4 | 48-01-122601 | 1N4448 Diode |
| D5,6,7,8,9 | 48-02-042787 | 1N4004 Diode |
| CR3,CR4 | 48-02-037580 | Bridge Rectifier |
| Q1,3 | 48-02-039501 | MAC224-6 600 Volt Triac |
| Q2,4,5,6,7 | 48-03-121306 | 2N3904 NPN Transistor |

RESISTORS

| | | |
|-----------|--------------|----------------|
| R1,R6,R13 | 47-01-102246 | 180 Ohm .5W 5% |
|-----------|--------------|----------------|

| | | |
|--------------|--------------|----------------|
| R4,R9 | 47-03-028173 | 100k .25 W 1% |
| R3,R8 | 47-03-109437 | 10k .25 W 1% |
| R2,R5,R7,R10 | 47-03-121532 | 1k .25 W 1% |
| R11 | 47-03-028242 | 4.75k .25 W 1% |
| W1-12 | 21-01-110310 | Jmpr Circuit |

CAPACITORS

| | | |
|-------------|--------------|-------------------------------|
| C4,7 | 15-01-050971 | 2200uF 160V Electrolytic |
| C13,15,16 | 15-01-050970 | 2200uF 50V Electrolytic |
| C1,2,5,6 | 15-06-039383 | .1uF 400V Metal Poly |
| C14,17,18 | 15-02-124808 | .1uF 50V Ceramic |
| C9,10,11,12 | 15-02-026884 | .01uF 250V Radial UL approved |

MISCELLANEOUS

| | | |
|-------------------|--------------|------------------------------|
| K1 | 45-01-051144 | Relay 5V |
| J4 | 21-01-050186 | 5 Pin Header .156" ctrs |
| J2A | 21-02-123239 | 10 Pin .1" ctrs |
| J5A-12A | 21-03-124541 | .25" Spade Term |
| J5-12 | 21-03-124541 | .25" Spade Term |
| Heatsink - Triac | 14-05-027783 | Heatsink Stamped tail |
| Htsnk - Regulator | 14-05-050433 | Heatsink Extruded / anodized |
| Regulator mntg | 28-01-026899 | Screw MCH 4-40 |
| Regulator mntg | 28-02-027389 | Nut Keps Hex 4-40 |
| Triac mounting | 28-01-124701 | Screw Rolox 4-40 |

PCB SUPPLY AP2400 (27-01-051149)

SEMICONDUCTORS

| | | |
|------------|--------------|------------------------------|
| U1, U2 | 17-02-039512 | MOC3041 Opto-Triac |
| U3 | 17-01-051179 | LM7806 6 volt regulator |
| U4 | 17-01-121660 | LM7815 15 volt regulator |
| U5 | 17-01-121659 | LM7915 neg 15 volt regulator |
| D1,2,3,4 | 48-01-122601 | 1N4448 Diode |
| D5,6,7,8,9 | 48-02-042787 | 1N4004 Diode |
| CR3,CR4 | 48-02-037580 | Bridge Rectifier |
| Q1,3 | 48-02-039501 | MAC224-6 600 Volt Triac |
| Q2,4,5,6,7 | 48-03-121306 | 2N3904 NPN Transistor |

RESISTORS

| | | |
|--------------|--------------|----------------|
| R1,R6,R13 | 47-01-102246 | 180 Ohm .5W 5% |
| R4,R9 | 47-03-028173 | 100k .25 W 1% |
| R3,R8 | 47-03-109437 | 10k .25 W 1% |
| R2,R5,R7,R10 | 47-03-121532 | 1k .25 W 1% |
| R11 | 47-03-028242 | 4.75k .25 W 1% |
| W1-12 | 21-01-110310 | Jmpr Circuit |

CAPACITORS

| | | |
|-------------|--------------|-------------------------------|
| C3,4,7,8 | 15-01-050971 | 2200uF 160V Electrolytic |
| C13,15,16 | 15-01-050970 | 2200uF 50V Electrolytic |
| C1,2,5,6 | 15-06-039383 | .1uF 400V Metal Poly |
| C14,17,18 | 15-02-124808 | .1uF 50V Ceramic |
| C9,10,11,12 | 15-02-026884 | .01uF 250V Radial UL approved |

MISCELLANEOUS

| | | |
|-------------------|--------------|------------------------------|
| K1 | 45-01-051144 | Relay 5V |
| J4 | 21-01-050186 | 5 Pin Header .156" ctrs |
| J2A | 21-02-123239 | 10 Pin .1" ctrs |
| J5A-12A | 21-03-124541 | .25" Spade Term |
| J5-12 | 21-03-124541 | .25" Spade Term |
| Heatsink - Triac | 14-05-027783 | Heatsink Stamped tell |
| Htsnk - Regulator | 14-05-050433 | Heatsink Extruded / anodized |

| REFERENCE | PART NUMBER | DESCRIPTION |
|-----------------------------------|--------------|-----------------------------|
| Regulator mntg | 28-01-026899 | Screw MCH 4-40 |
| Regulator mntg | 28-02-027389 | Nut Keps Hex 4-40 |
| Triac mounting | 28-01-124701 | Screw Rolox 4-40 |
| CHASSIS HARDWARE AND CABLE | | |
| Ear mntg screws | 28-01-124842 | Screw # 8x1/4 Rolox B.O PHP |
| Driver brd hinge | 28-01-124842 | Screw # 8x1/4 Rolox B.O PHP |
| Driver brd hinge | 28-04-051242 | Washer Nylon Shoulder #8 |
| Top & rear panel | 28-01-121967 | Screw # 6x1/4 Rolox, BO PHP |
| Frrnt panel screws | 28-01-114318 | Screw # 6x1/4 MCH BO PHP |
| Rear Panel mntg | 28-01-124580 | Screw 6-32x3/16 PHP Rolox |
| Fan Bracket mntg | 28-02-114116 | Nut Keps 6-32 |
| Fan mntg screws | 28-01-110787 | Screw Type B # 6x1/4 BO |
| Input Panel mntg | 28-01-121967 | Screw # 6x1/4 Rolox, BO PHP |
| XLR mntg screws | 28-01-026899 | Screw #4x5/16 MCH BO PHP |
| PCB Mounting | 28-01-113868 | Screw # 6x 5/16 MCH STL PHP |
| Earth ground | 28-02-114116 | Nut Keps 6-32 |
| Main Heatsink | 28-01-113870 | Screw # 6x1/2 MCH PHD Head |
| Rack Mntg | 28-13-026422 | Hardware kit |
| | 10-01-051243 | Amp / Driver Cable |
| | 10-01-051244 | Display / Driver Cable |
| | 10-01-051245 | Pwr Supply / Driver Cable |

| REFERENCE | PART NUMBER | DESCRIPTION |
|--------------------|--------------|-----------------------------|
| | 10-01-051247 | WirePrep LD SW / Xlfr Harn |
| SW2, SW3 | 51-02-039502 | Load switch DPDT 15 amp |
| | 51-04-100459 | Fuse Holder |
| SW1 | 51-02-124582 | Pwr Switch |
| | 28-09-124596 | Strain Relief, Heyco |
| Power Cord | 60-06-051246 | CBL Line 18 GA |
| | 32-08-051064 | Air Filter |
| Fan conn housing | 21-02-121395 | Conn Housing 2 pos |
| Fan conn terminal | 21-03-121397 | Term Crimp |
| AP2400 ONLY | | |
| | 10-01-051647 | WirePrep |
| F1 | 51-04-105890 | Fuse 10A |
| | 56-08-051555 | Pwr Transformer |
| | 35-01-051239 | FAN-Cross-Flo 24 VDC 10.75" |
| CR1,2 | 48-02-122651 | 25 Amp Bridge Rect |
| Mntg Bridge Rect | 28-02-114122 | Nut Keps 8-32 |
| AP2200 ONLY | | |
| | 10-01-051634 | WirePrep |
| F1 | 51-04-051254 | Fuse 7A |
| | 56-08-051253 | Pwr Transformer |
| | 35-01-051240 | FAN-Cross-Flo 24 VDC 4.6" |

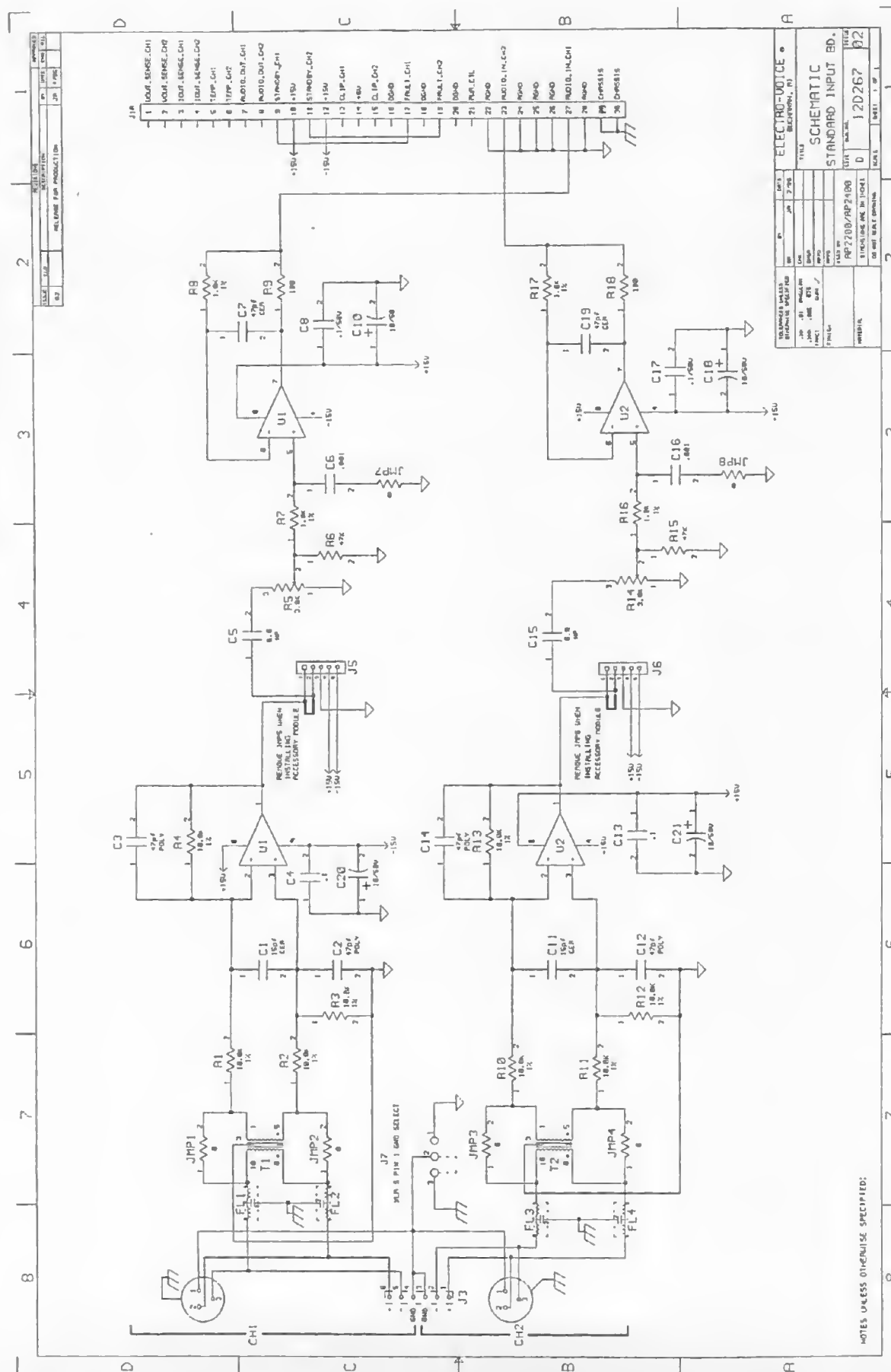
INPUT CARD PIN ASSIGNMENTS

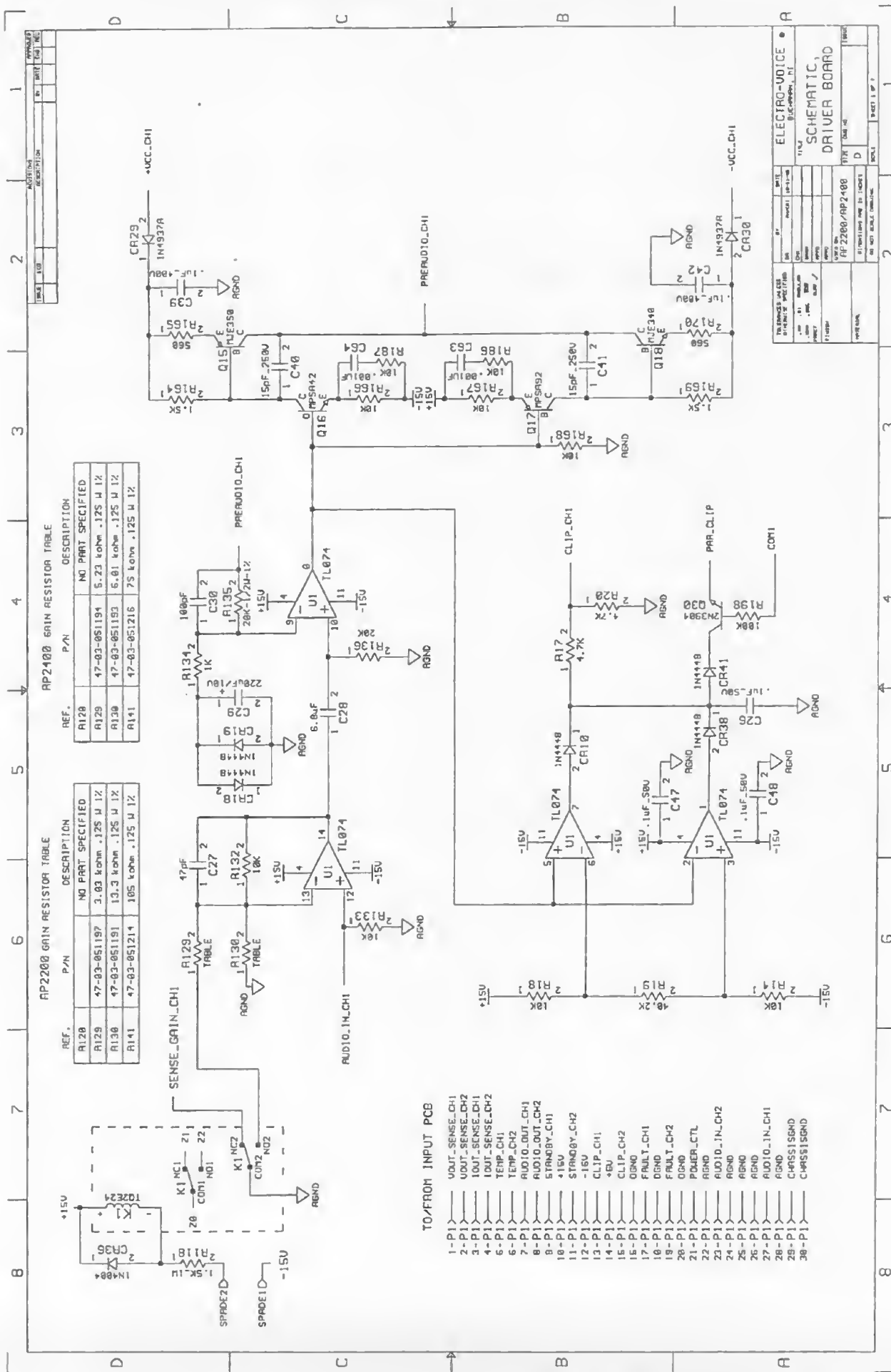
The input module connects to the amplifier via a 30-pin connector. The amplifier provides various signals and controls through this connector. The following is a brief description of each pin function.

| PIN# | NAME | FUNCTION |
|------|----------------|---|
| 1 | VOUT_SENSE_CH1 | 0 to 5 Volt DC signal that represents the load voltage for channel 1. |
| 2 | VOUT_SENSE_CH2 | Same as above but for channel 2. |
| 3 | IOUT_SENSE_CH1 | 0 to 5 Volt DC signal that represents the load current for channel 1. |
| 4 | IOUT_SENSE_CH2 | Same as above but for channel 2. |
| 5 | TEMP_CH1 | 0 to 5 Volt DC signal that indicates the channel 1 heat sink temperature. Scale is 25 to 100°C. |
| 6 | TEMP_CH2 | Same as above but for channel 2. |
| 7 | AUDIO_OUT_CH1 | Channel one output scaled down for 0 dBu full scale. Can be used for monitoring or line out. |
| 8 | AUDIO_OUT_CH2 | Same as above but for channel 2. |
| 9 | STANDBY_CH1 | Control signal turns channel 1 power supply on by forcing pin to agnd. Normally it is connected to the channel 1 fault signal pin 17. |
| 10 | +15V | 15 volt DC supply with 100 mA capacity. |
| 11 | STANDBY_CH2 | Same as pin 9 but for channel 2. |
| 12 | -15V | -15 volt DC supply with 100 mA capacity. |
| 13 | CLIP_CH1 | 0 to 8 volt signal. Indicates a clip condition by going high (> 4 volts). |
| 14 | +5V | 6 volt DC supply with 800 mA capacity reference only to DGND. |
| 15 | CLIP_CH2 | Same as pin 13 but for channel 2. |

| PIN# | NAME | FUNCTION |
|------|--------------|--|
| 16 | DGND | Reference for 6 volt DC supply (pin 14). |
| 17 | FAULT_CH1 | Normally connected to STANDBY_CH1. Indicates either critical temperature, over-current, output DC or shorted output devices by going high (> 5 volts). Normally this signal is low (< 1 volt). It is referenced to AGND. |
| 18 | DGND | Same as pin 16. |
| 19 | FAULT_CH2 | Same as pin 17 but for channel 2. |
| 20 | DGND | Same as pin 16. |
| 21 | POWER_CTL | Shorting this pin to DGND will power down the entire amplifier with the exception of the 6 volt DC supply. |
| 22 | AGND | Analog, fault and +15 volt supply ground reference. |
| 23 | AUDIO_IN_CH2 | Input to power amplifier. Unbalanced and referenced to AGND. Sensitivity is 0.775 Vrms. |
| 24 | AGND | Same as pin 22. |
| 25 | AGND | Same as pin 22. |
| 26 | AGND | Same as pin 22. |
| 27 | AUDIO_IN_CH1 | Same as 23 but for channel 1. |
| 28 | AGND | Same as pin 22. |
| 29 | CHASSISGND | Connects to the chassis ground inside of the amplifier. |
| 30 | CHASSISGND | Same as above. |

SCHEMATICS/INPUT BOARD

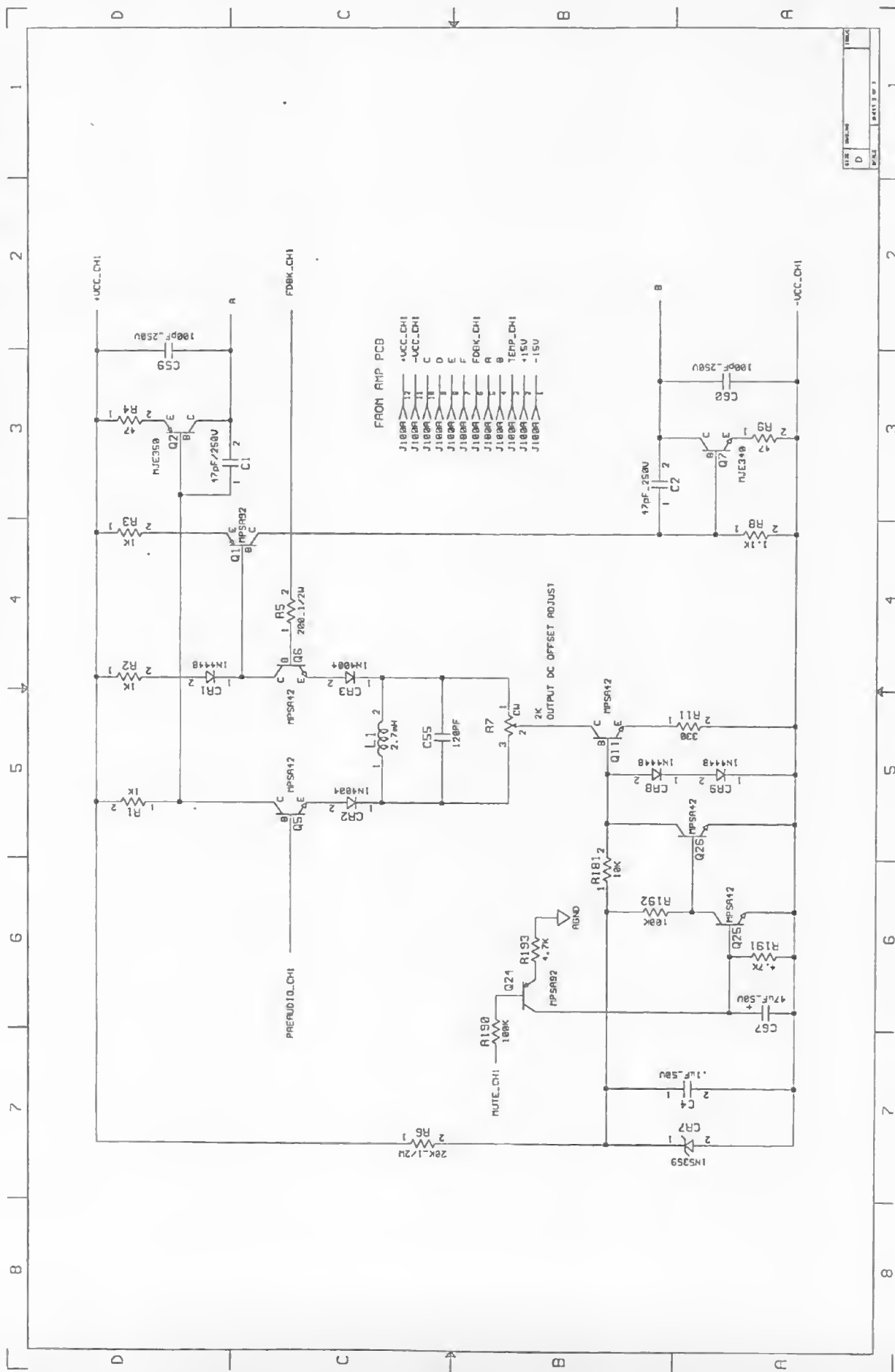




| | |
|-------------------------|--------------------------|
| ELECTRO-VOICE | |
| DATE | 1978-10-10 |
| BY | W. J. B. / J. B. / J. B. |
| CHKD | W. J. B. / J. B. / J. B. |
| APP'D | W. J. B. / J. B. / J. B. |
| SCHEMATIC, DRIVER BOARD | |
| FILE | 22200/2400 |
| REV | 1 |
| DATE | 1978-10-10 |
| BY | W. J. B. / J. B. / J. B. |
| CHKD | W. J. B. / J. B. / J. B. |
| APP'D | W. J. B. / J. B. / J. B. |
| NOT FOR MANUFACTURE | |

SCHEMATICS/DRIVER BOARD

SCHEMATICS/DRIVER BOARD



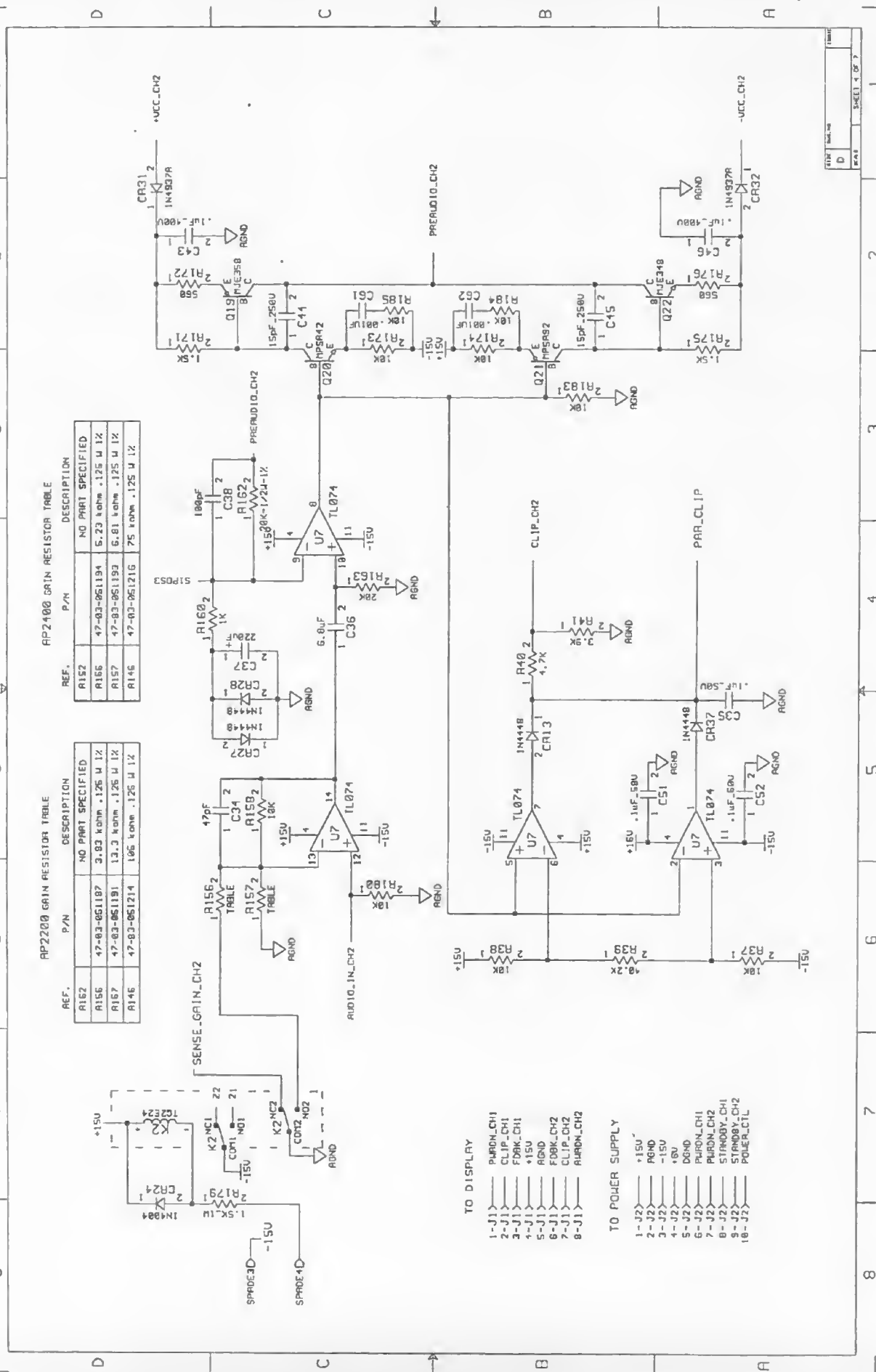
SCHEMATICS/DRIVER BOARD

AP2200 GAIN RESISTOR TABLE

| REF. | P/N | DESCRIPTION |
|------|--------------|---------------------|
| A152 | | NO PART SPECIFIED |
| A155 | 47-83-061197 | 3.83 kohm .125 u 1% |
| A157 | 47-83-061191 | 13.3 kohm .125 u 1% |
| A146 | 47-83-061214 | 106 kohm .125 u 1% |

AP2400 GAIN RESISTOR TABLE

| REF. | P/N | DESCRIPTION |
|------|--------------|---------------------|
| A152 | | NO PART SPECIFIED |
| A155 | 47-83-061194 | 5.23 kohm .125 u 1% |
| A157 | 47-83-061193 | 6.81 kohm .125 u 1% |
| A146 | 47-83-061216 | 75 kohm .125 u 1% |



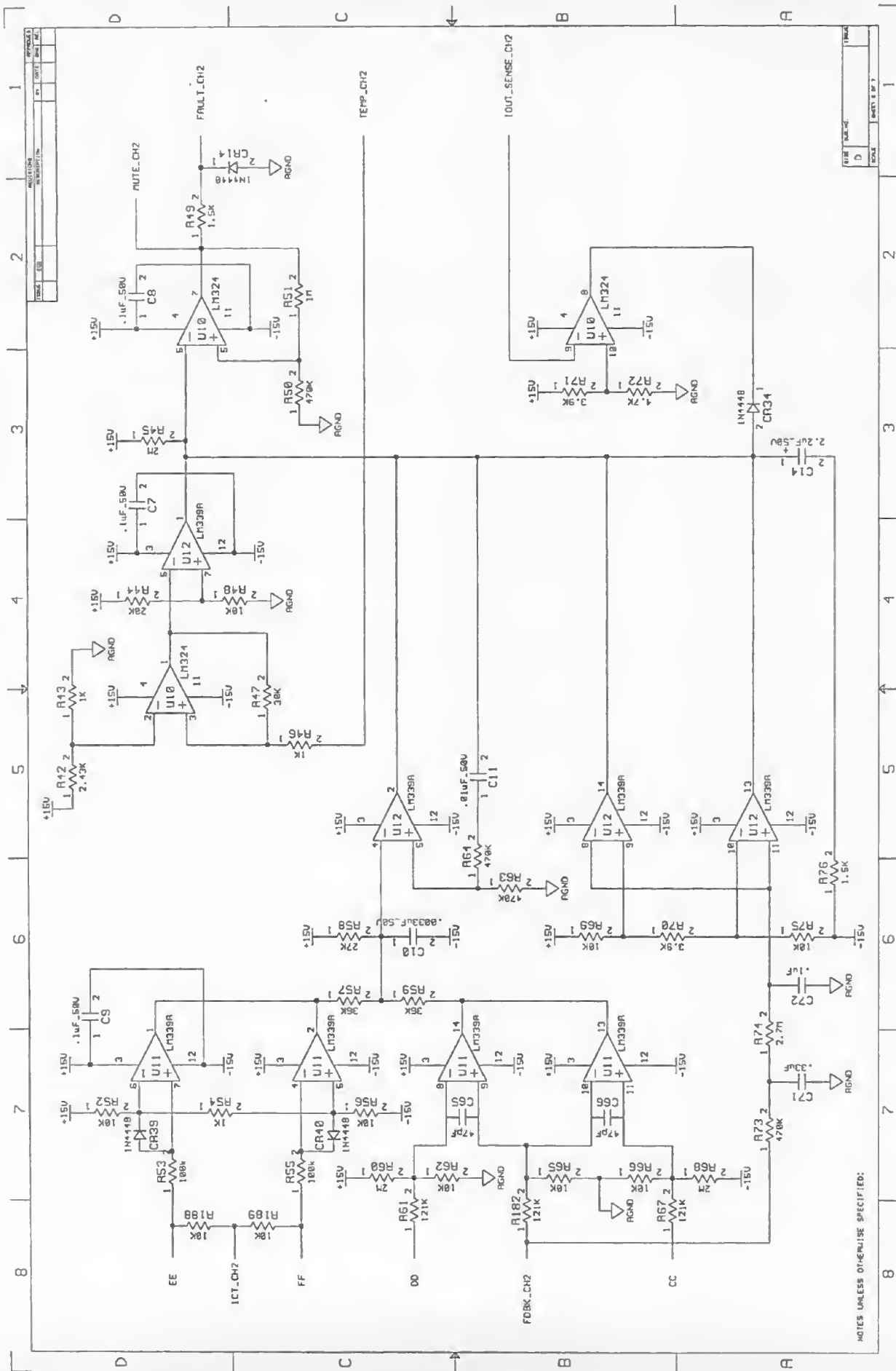
TO DISPLAY

- 1-J1 > PARON_CH1
- 2-J1 > CLIP_CH1
- 3-J1 > FDRK_CH1
- 4-J1 > +15V
- 5-J1 > AGND
- 6-J1 > FDRK_CH2
- 7-J1 > CLIP_CH2
- 8-J1 > PARON_CH2

TO POWER SUPPLY

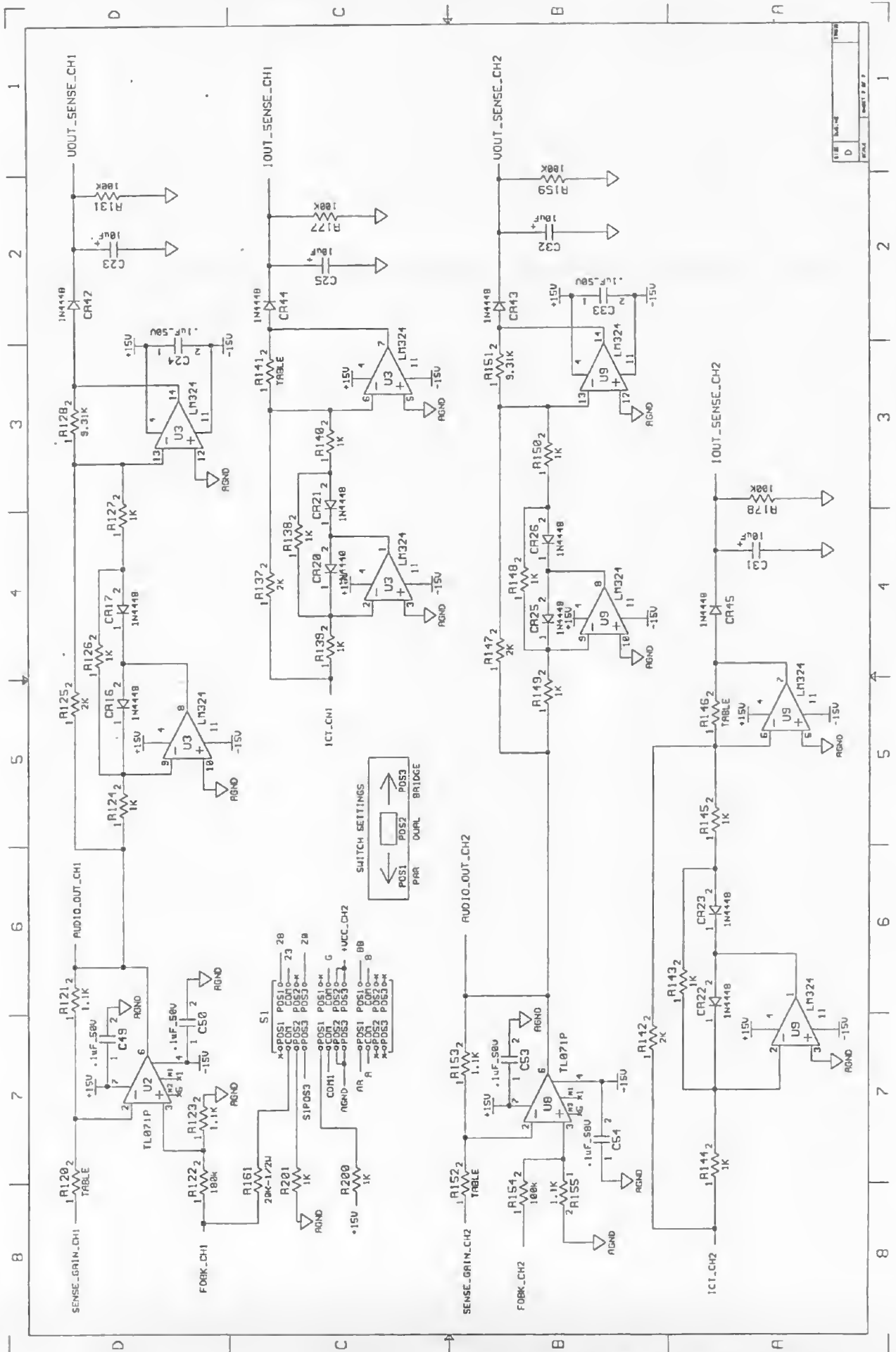
- 1-J2 > +15V
- 2-J2 > AGND
- 3-J2 > -15V
- 4-J2 > +6V
- 5-J2 > DGN0
- 6-J2 > PARON_CH1
- 7-J2 > PARON_CH2
- 8-J2 > STANDBY_CH1
- 9-J2 > STANDBY_CH2
- 10-J2 > POWER_CTL

SCHEMATICS/DRIVER BOARD

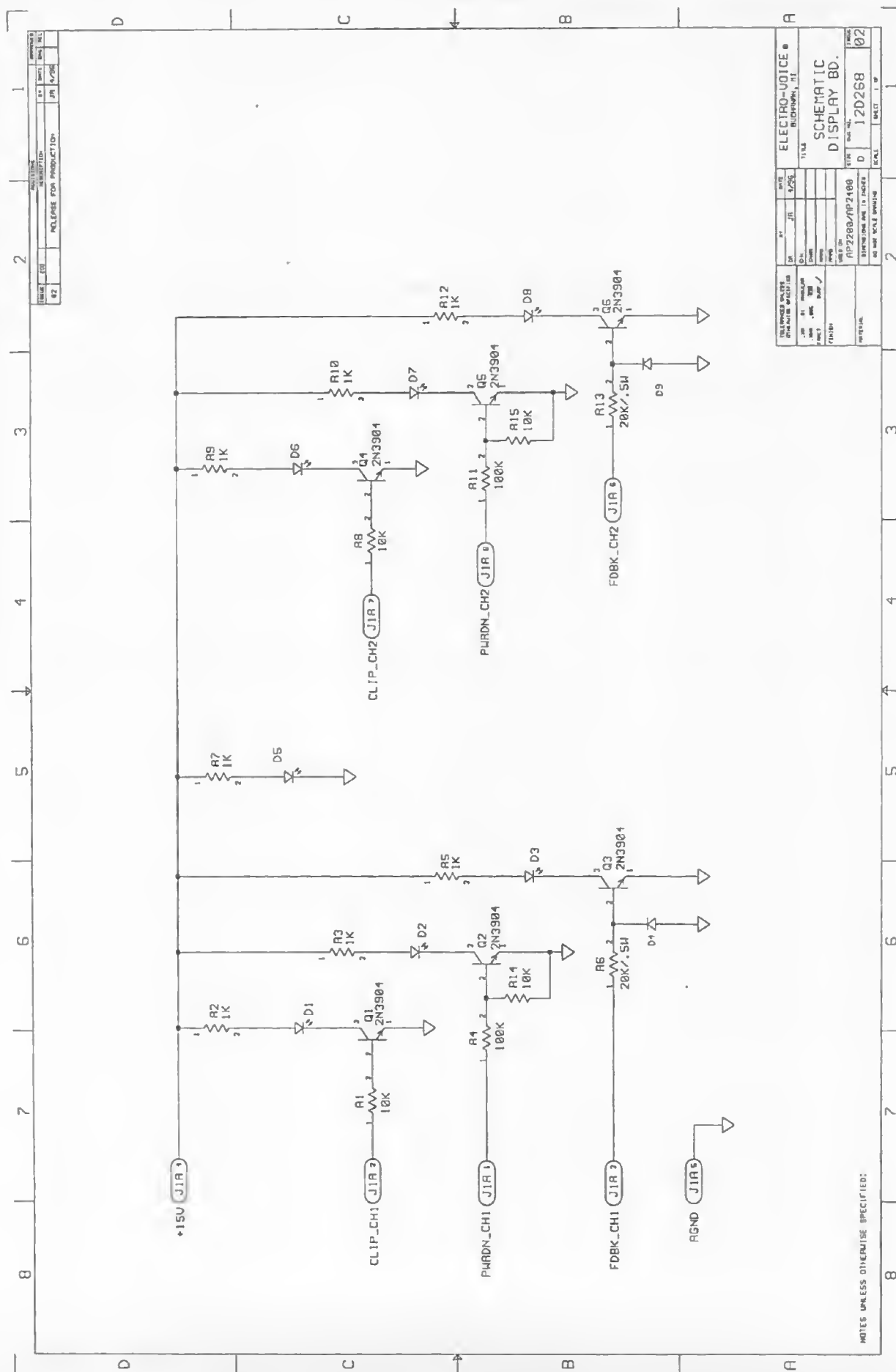


NOTES UNLESS OTHERWISE SPECIFIED:

SCHEMATICS/DRIVER BOARD

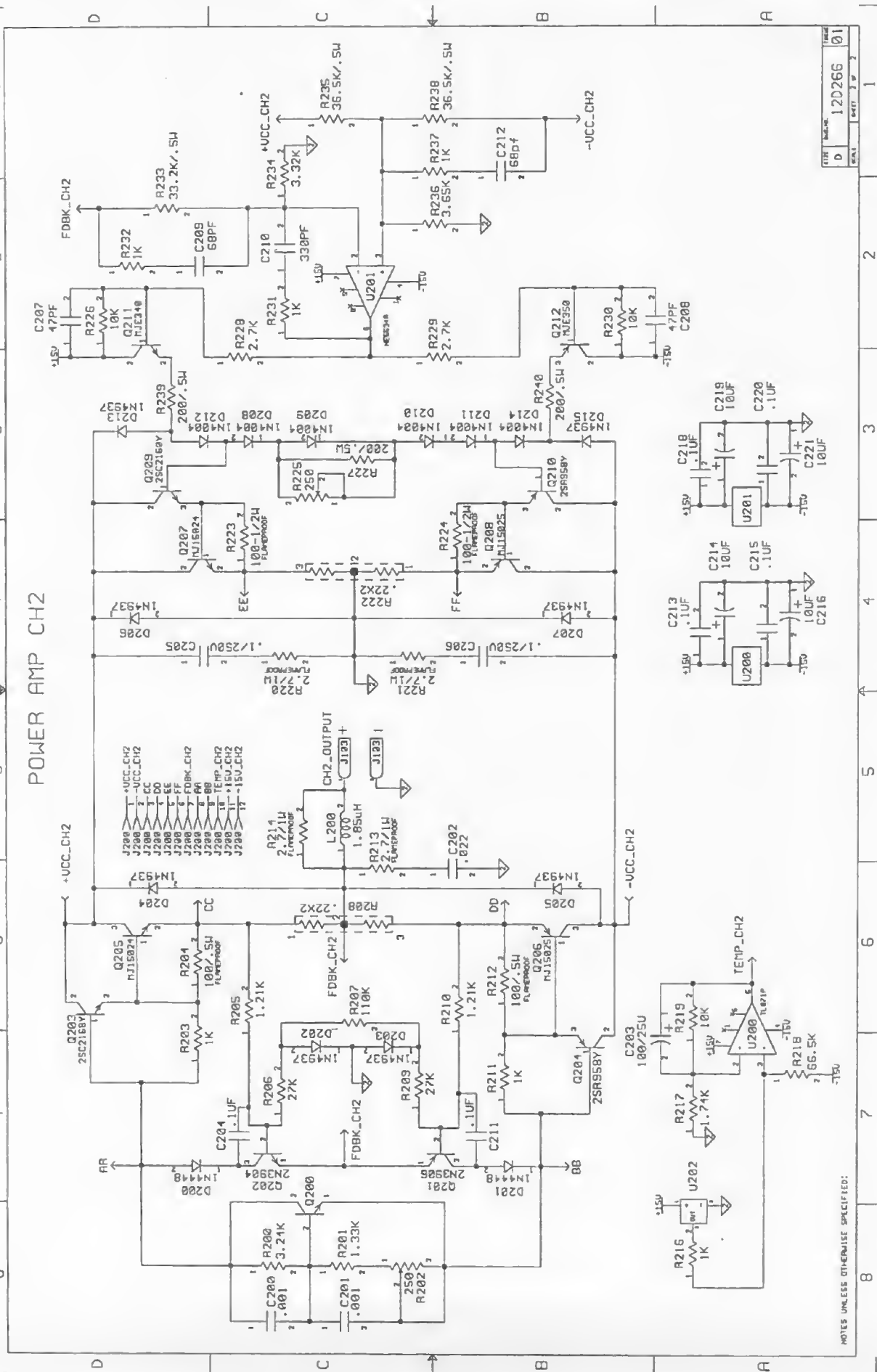


SCHEMATICS/DISPLAY BOARD



SCHEMATICS/POWER AMP CHANNEL 2

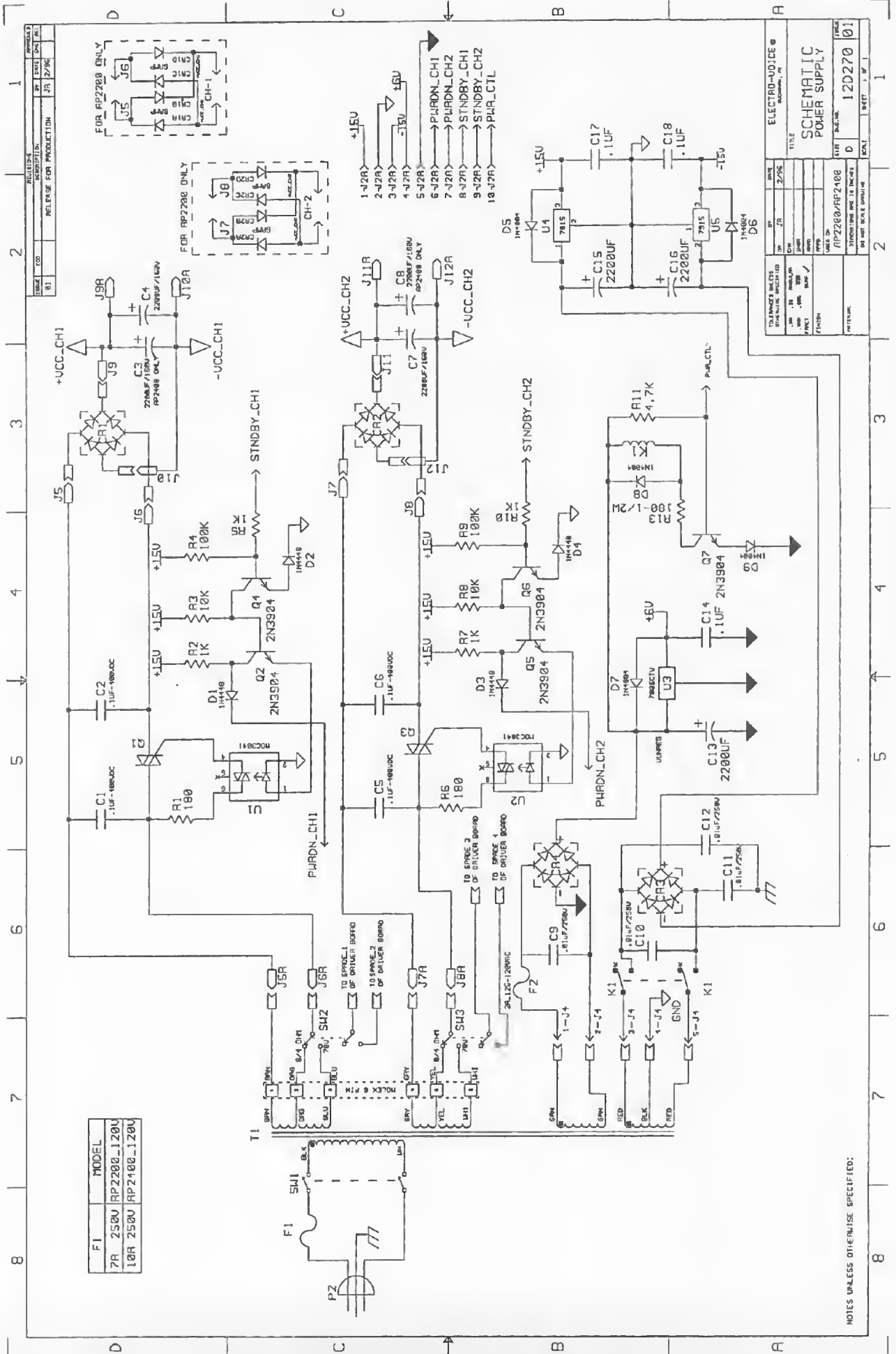
POWER AMP CH2



NOTES UNLESS OTHERWISE SPECIFIED:

| REV | DATE | BY | CHKD | APPD |
|-----|--------|----|------|------|
| D | 120266 | | | |

SCHEMATICS/POWER SUPPLY BOARD





Electro-Voice®

FACTORY SERVICE

If there is not an authorized service representative in your area you can ship the unit in its original packing prepaid to:

Mark IV Audio Service

600 Cecil Street
Buchanan, MI 49107
USA

OR

Mark IV Audio Service

9130 Glenoaks Blvd
Sun Valley, CA 91352

For a listing of authorized service representatives write to:

Mark IV Audio Service

600 Cecil Street
Buchanan, MI 49107
USA

or call: 1-800-234-6831 or FAX 616-695-4743

To obtain warranty service, a customer must deliver the product, prepaid, to Mark IV Audio Service or any of its authorized service representatives together with proof of purchase of the product in the form of a bill of sale or receipted invoice.

TECHNICAL ASSISTANCE

For applications assistance or other technical information, call: 1-800-234-6831

ACCESSORIES

For information on accessories contact
Mark IV Audio Service at
1-800-234-6831 or FAX 616-695-4743

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